VECTOR

PREEvision: Beyond Requirements Engineering

REConf 2025 | Munich | May 05 – 07, 2025 | Dr.-Ing. Nico Adler, Dr. Andreas Reichenbacher

Agenda

- **Introduction**
  - Cyber-physical Systems are a Challenge
  - Regulations and Standards to Consider
  - PREEvision: Beyond Requirements Engineering
  - Summary

Vector: Facts and Figures

Our Mission:

Vector provides **OEMs and suppliers of automotive and related industries** with a professional and open development platform of **tools, software components and services** for creating **embedded systems**.

Employees:
> 4,500
Vectorians

Turnover:
1.01 bn €
in 2024

Associations:
participation in
16 committees

Customers:
> 9,000 companies
in 76 countries

Subsidiaries:
33 locations in
14 countries

Affiliated Companies:
CSM | EYYES | GiN

Development partner
for over 35 years

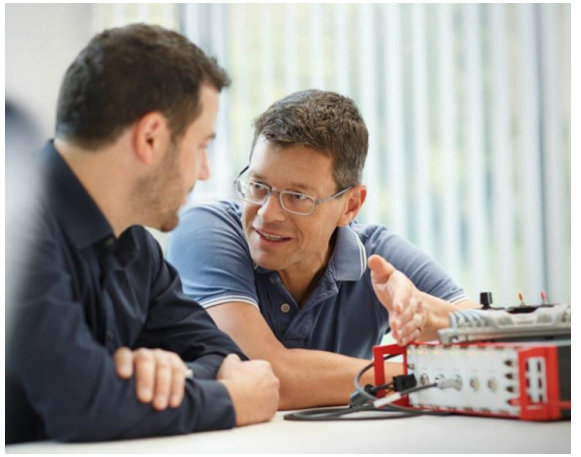
Our Portfolio: Application Areas and Product Examples

Development of Distributed Systems
PREEvision

⬅ Focus of this Presentation

Embedded Software and Systems
MICROSAR, CANbedded, DaVinci, Customer Projects on SDV / Vehicle OS

Testing
CANoe, CANalyzer, vTESTstudio, HIL systems, CI/CT solution, VectorCAST



Diagnostics & Flashing
CANdelaStudio, Indigo, vFlash, CANoe.DiVa, vService

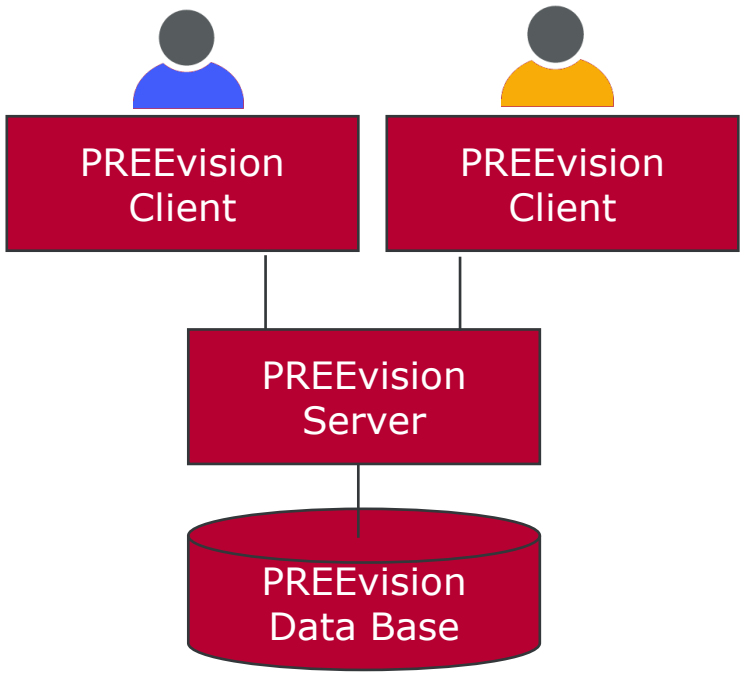
ECU Calibration
CANape, Calibration Data Management vCDM, VX1000

Measurement Technology
vMeasure, vSignalyzer, vMDM, Logger, Analog Measurement Devices

Consulting
Consulting Services, Engineering Services

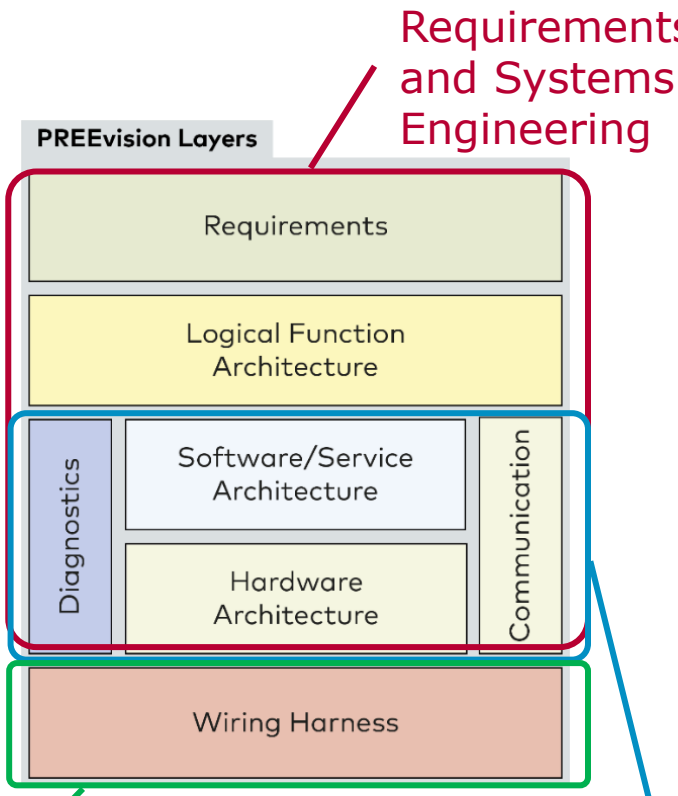
PREEvision: Use Cases and References

Product



Multi-User Collaboration Platform

Use Cases



Wiring Harness Design

Software, Communication and Diagnostics Design

References

- Automotive OEMs
- Commercial Vehicle OEMs
- Agriculture Machinery Providers
- Two Wheeler Manufacturers
- Engine Manufacturers
- ⋮
- Lithography System Providers

Agenda

Introduction

- **Cyber-physical Systems are a Challenge**

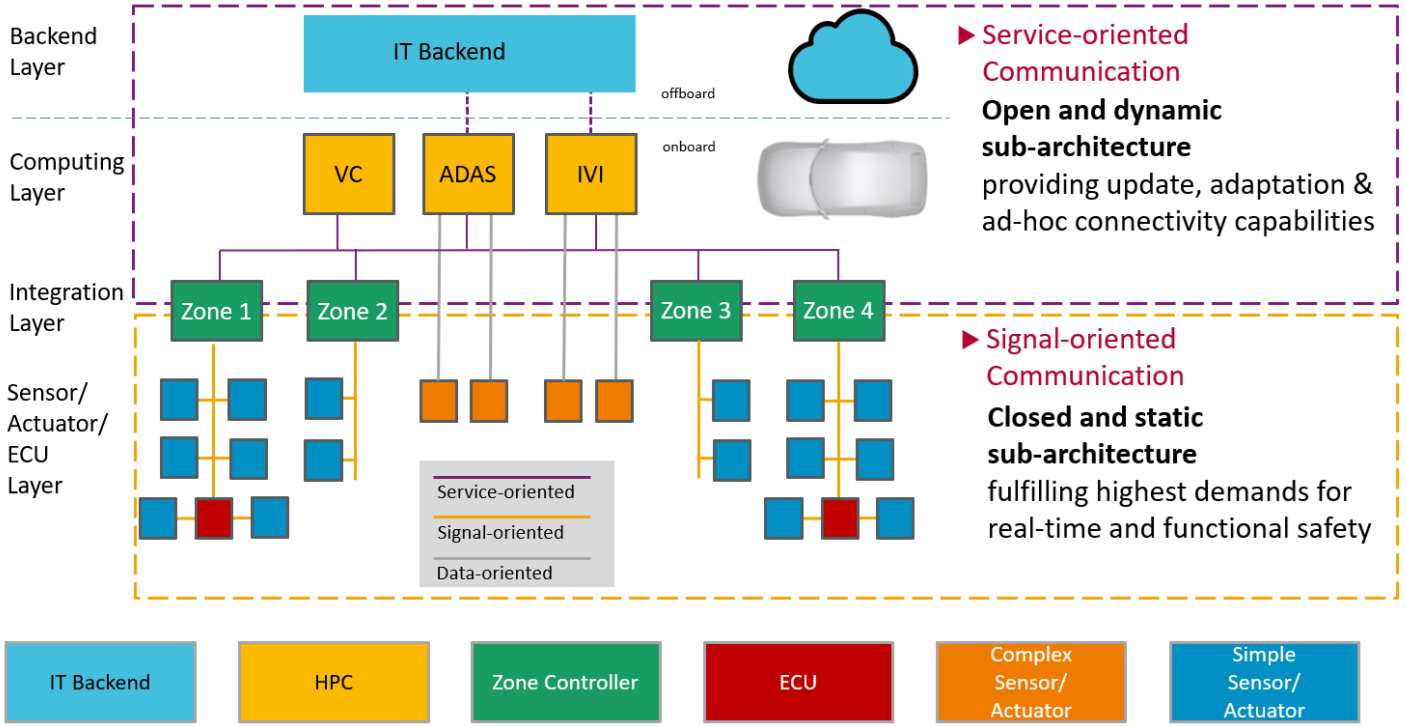
Regulations and Standards to Consider

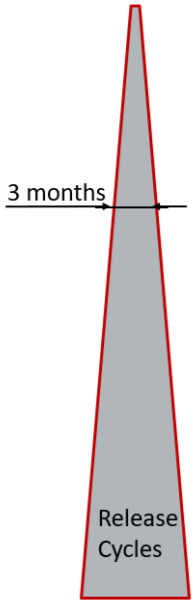
PREEvision: Beyond Requirements Engineering

Summary

What Is a System in the Context of Automotive E/E Engineering?

E/E Architectures of Software-defined Vehicles (SDVs) are centralized and hierarchical

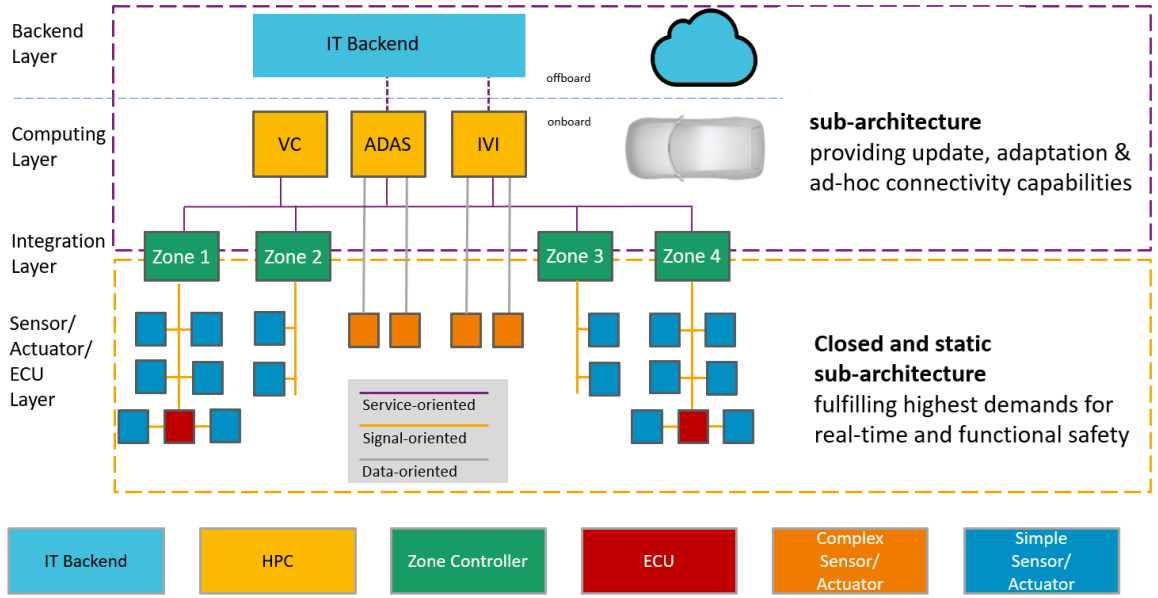




- SDVs are cyber-physical systems
- … with 2 sub-architectures
- … enable over the air SW updates and upgrades beyond Start of Production
- SW is never done!
- We see different SW update cycles on the different system layers.

- **A system of systems: Systems Engineering must manage the entire network**
  - from the IT Backend to the High-Performance Computers, zone controllers, ECUs, sensors and actuators
  - from power supplies to wiring harness
  - including the requirements, test specifications and traceability needed for functional safety reasons
  - and the architecture describing the complete system.

Why Model-based Systems Engineering (MBSE) instead of Working With Documents?



- SDVs have a disruptive product architecture
- … with an increasing diversity of system elements
- … and an increasing system complexity.

! MBSE is the right approach

- ✔ to deal with „Systems of Systems" and to oversee the complexity
- ✔ to enable a clear picture of relations, dependencies and life cycles of the system elements
- ✔ for traceability
- ✔ essential to manage the always changing stakeholder requirements and to determine their impacts
- ✔ necessary to meet functional and technical safety requirements
- ✔ A fine granular data model enables a fully transparent single point of truth, while documents are text-based black boxes

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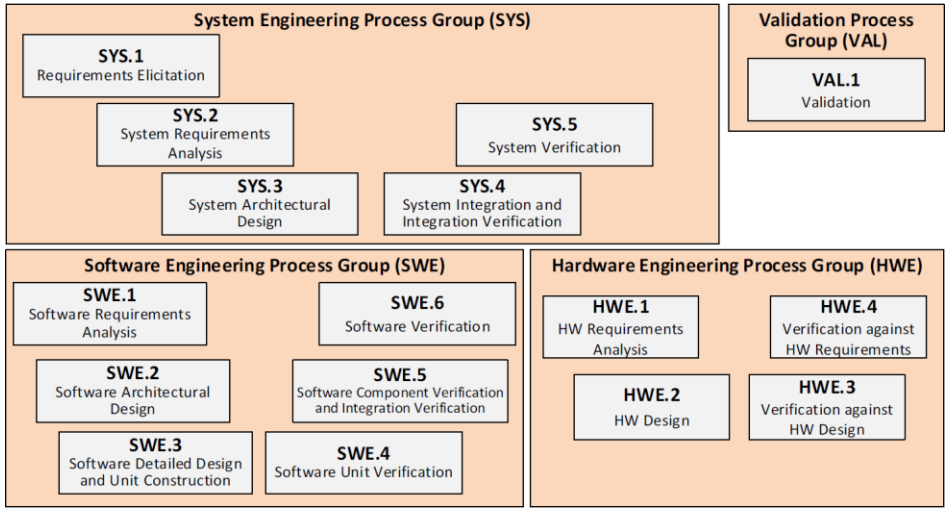
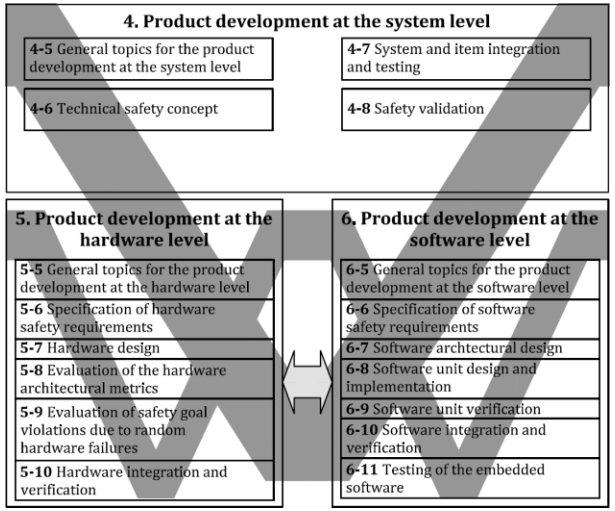
Model-Based Systems Engineering Framework

Regulations and Standards in Automotive

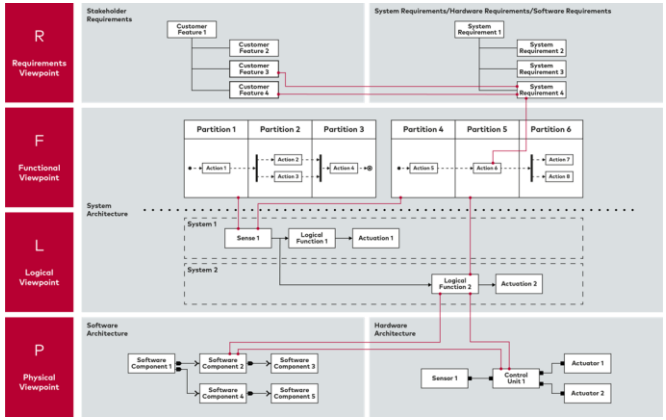
- **ASPICE**
- **ISO 26262**





Methodologies

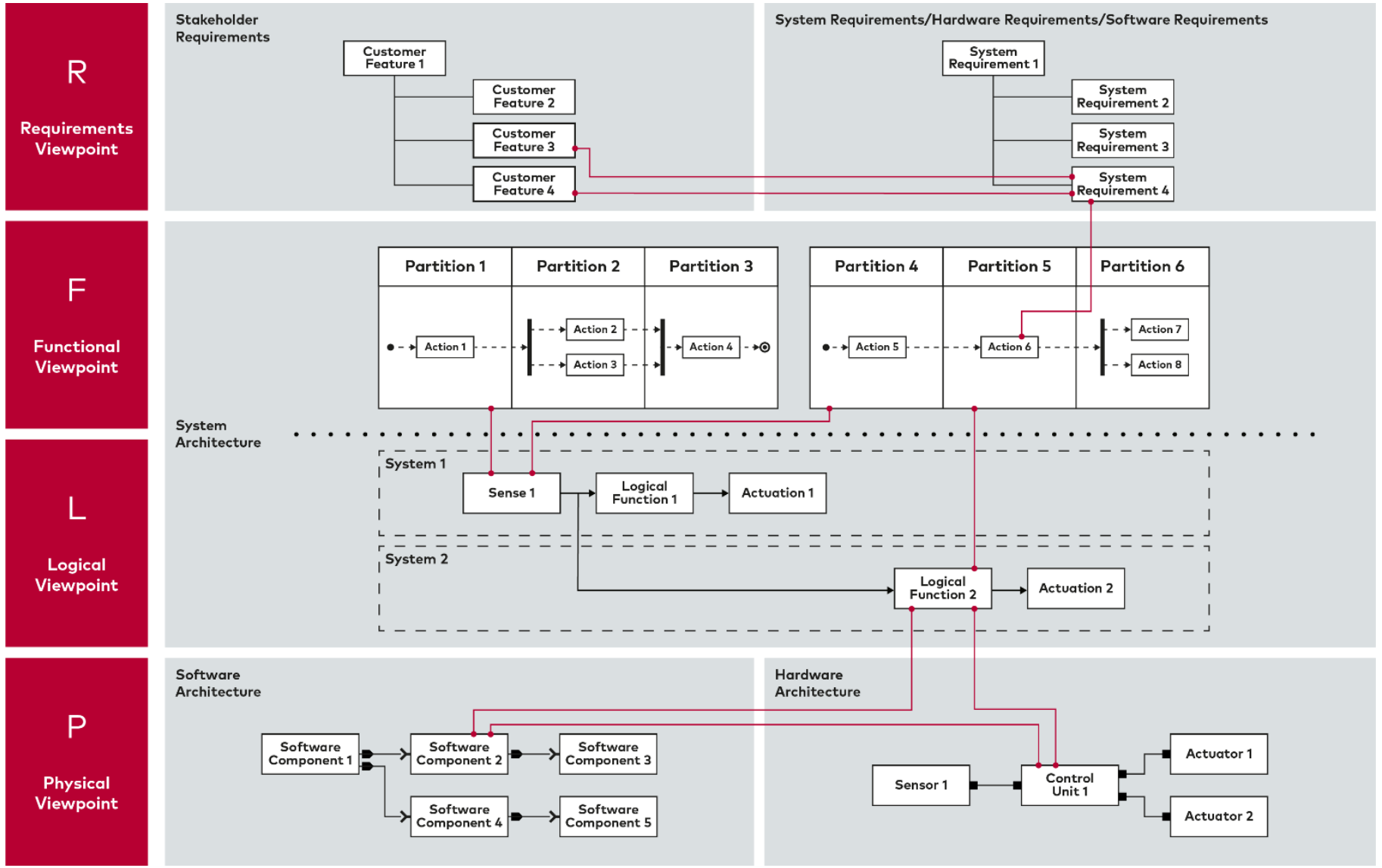
- **RFLP**



Modeling Languages

- **SysML**

The RFLP Methodology



Stakeholder and System Requirements

Isolated Perspective for every System

- from sensors to actuators
- from inputs to outputs

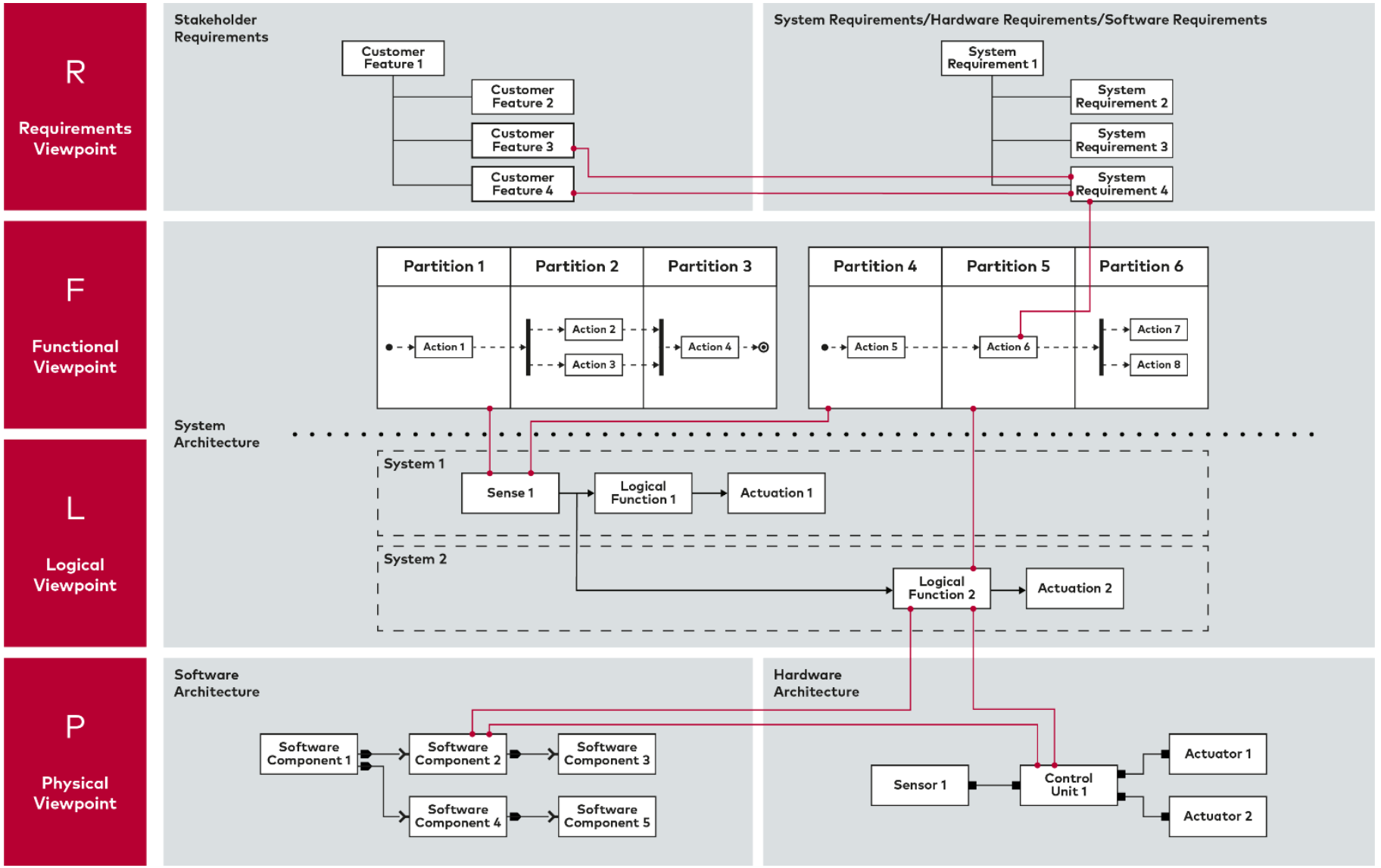
Integrated Perspective of all Systems

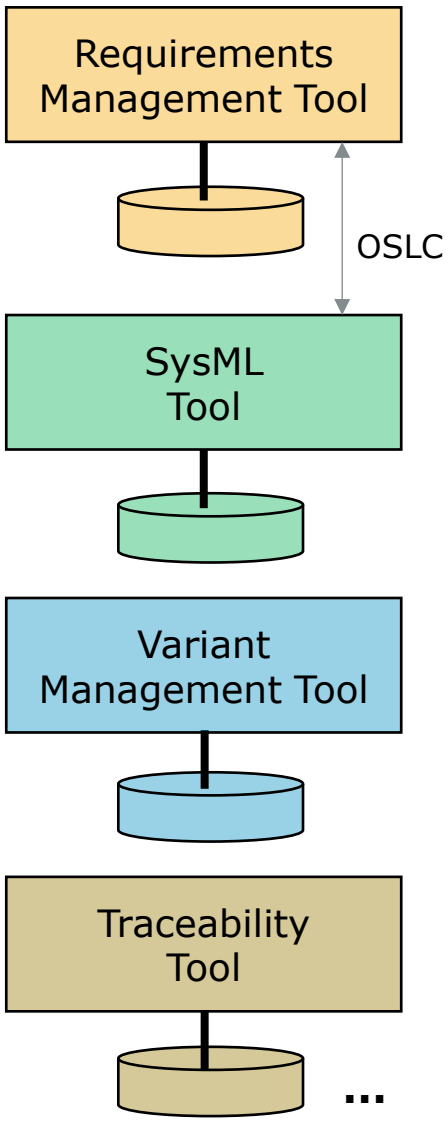
- shared sensors
- shared actuators
- System interfaces

Physical Architecture

- Hardware
- Software

Typical Tool Support





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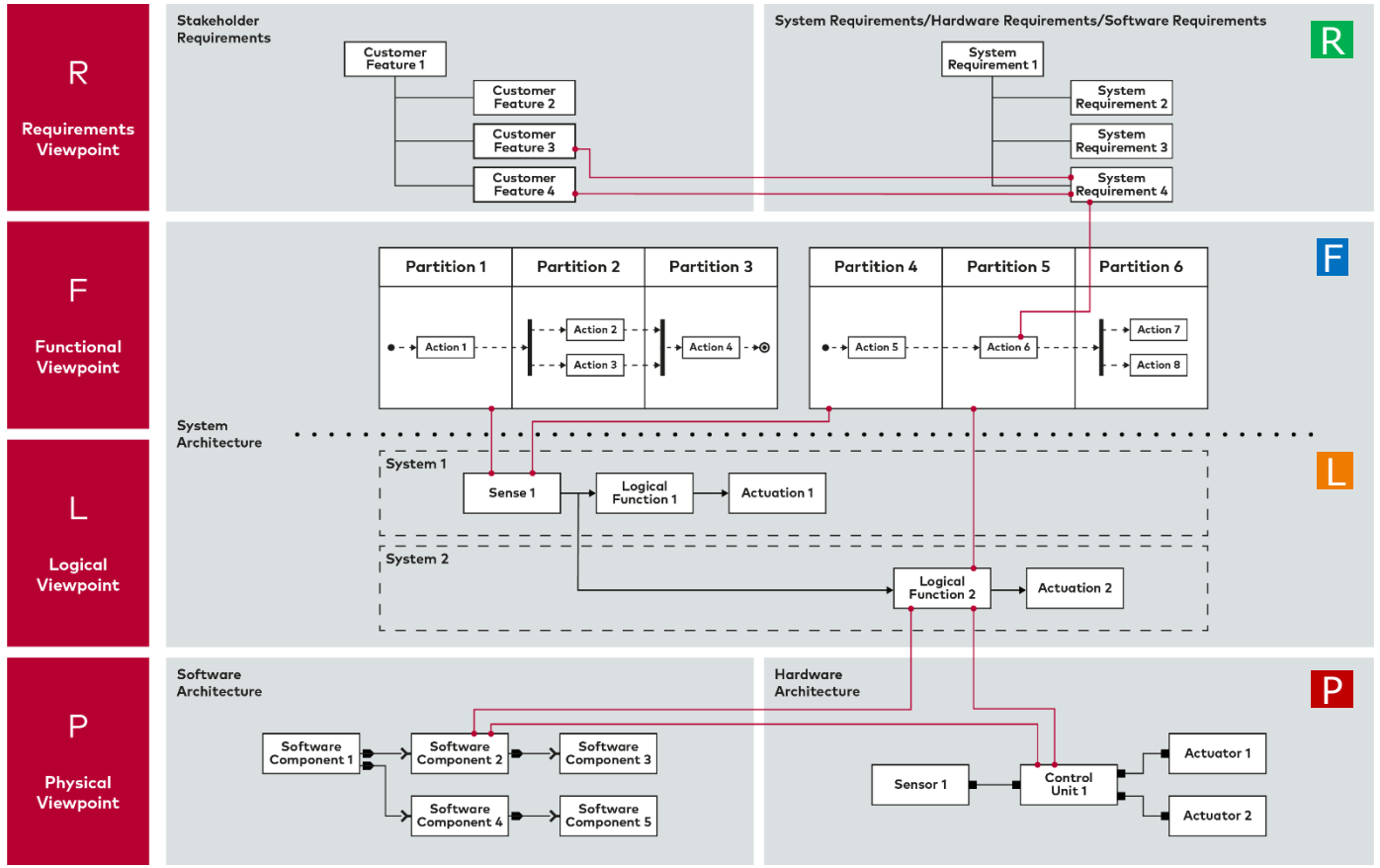
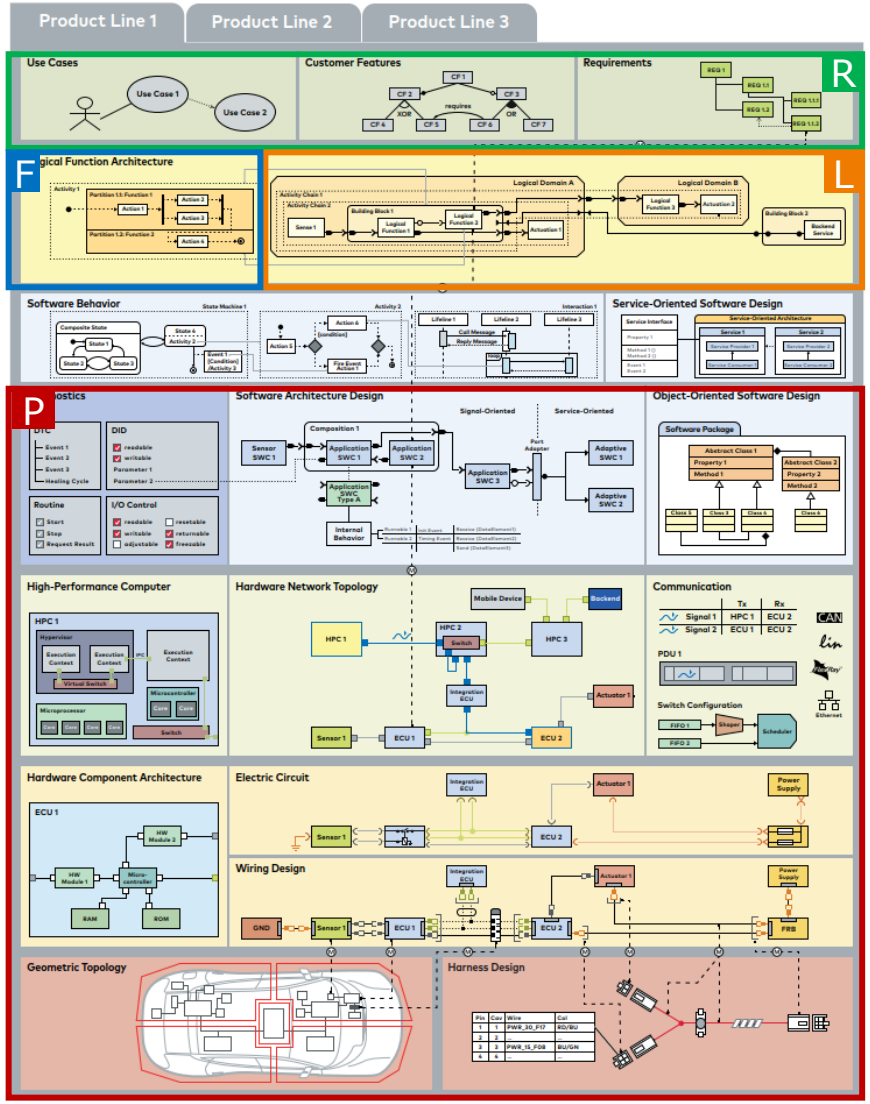
The RFLP Methodology in PREEvision



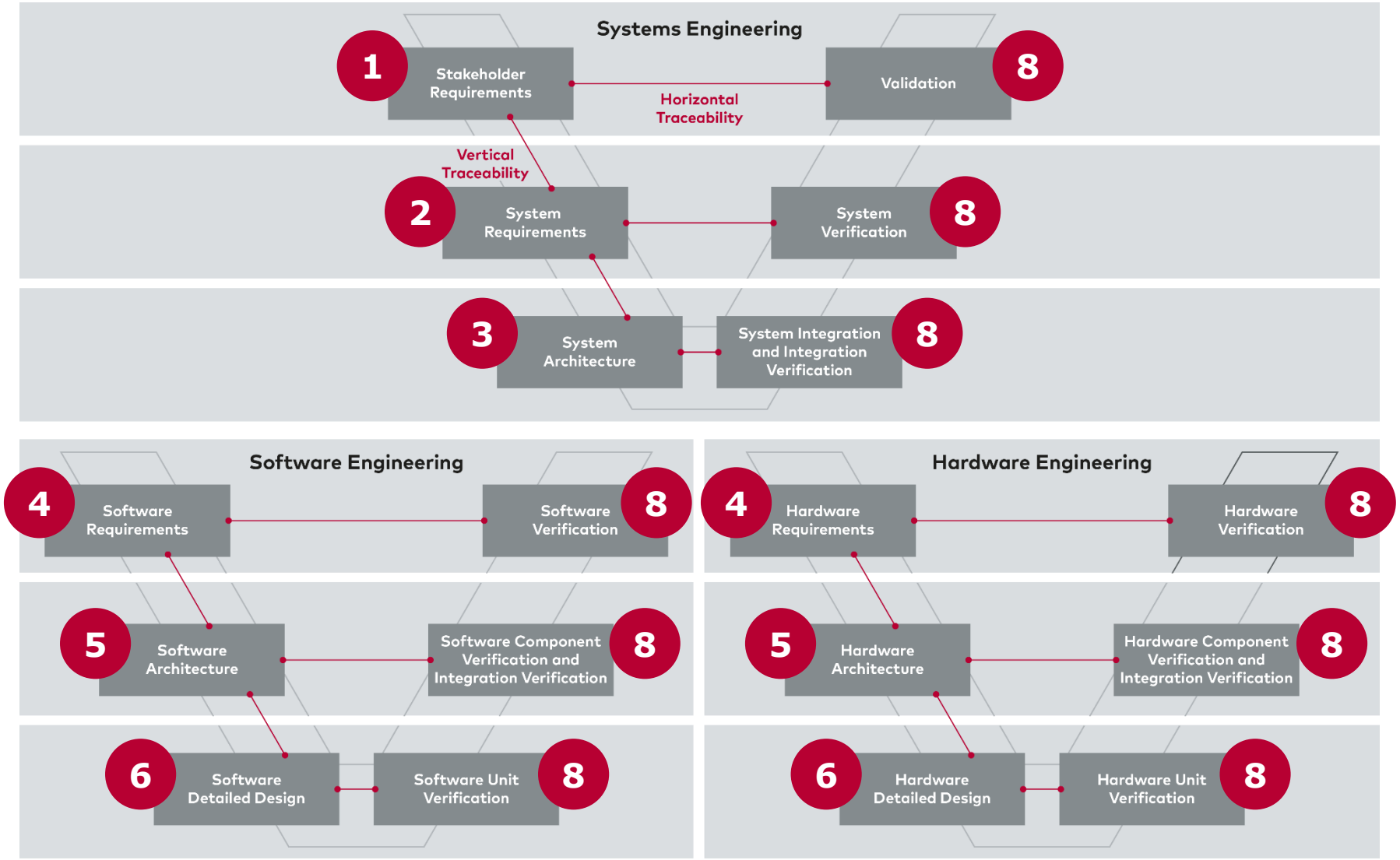
PREEvision supports RFLP completely

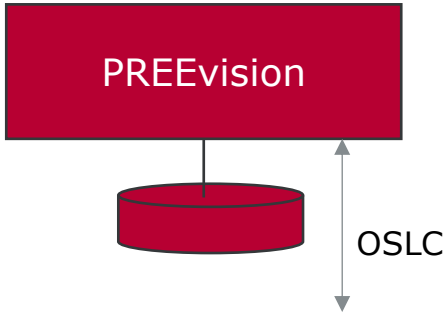


Main Steps to Perform MBSE

1. **Elicitation of stakeholder requirements**
2. **Analysis of the “problem area” and specification of system requirements**
3. **Design of the system architecture: Derive functionality, which must be fulfilled from the system and specify the system architecture**
4. **Specification of hardware and software requirements**
5. **Decomposition of the system and specification of the physical hardware and software architecture**
6. **Detailed design of software and hardware**
7. **Implementation of software and hardware**
8. **Verification, integration, validation … and delivery**

Processes according to ASPICE and ISO 26262



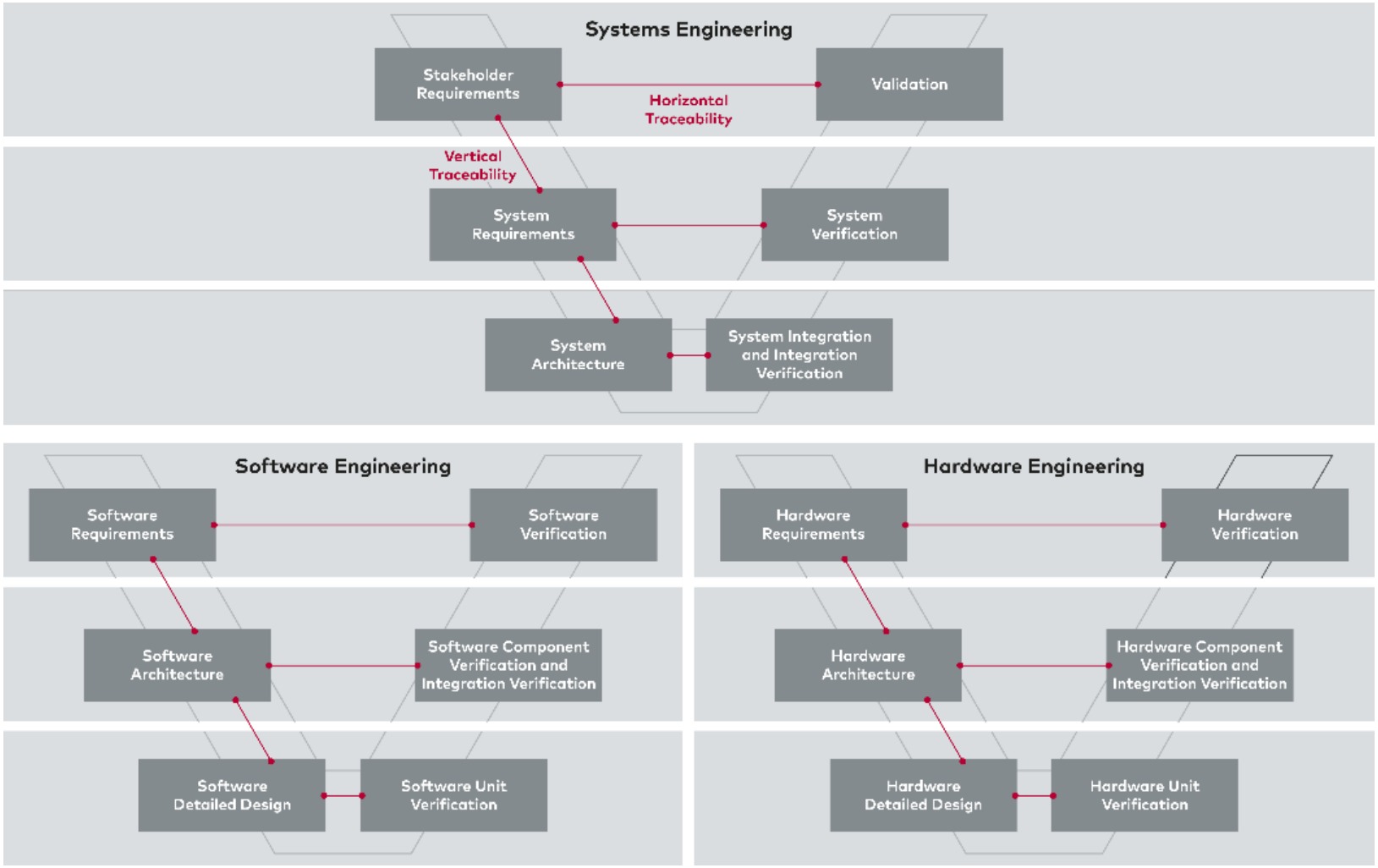


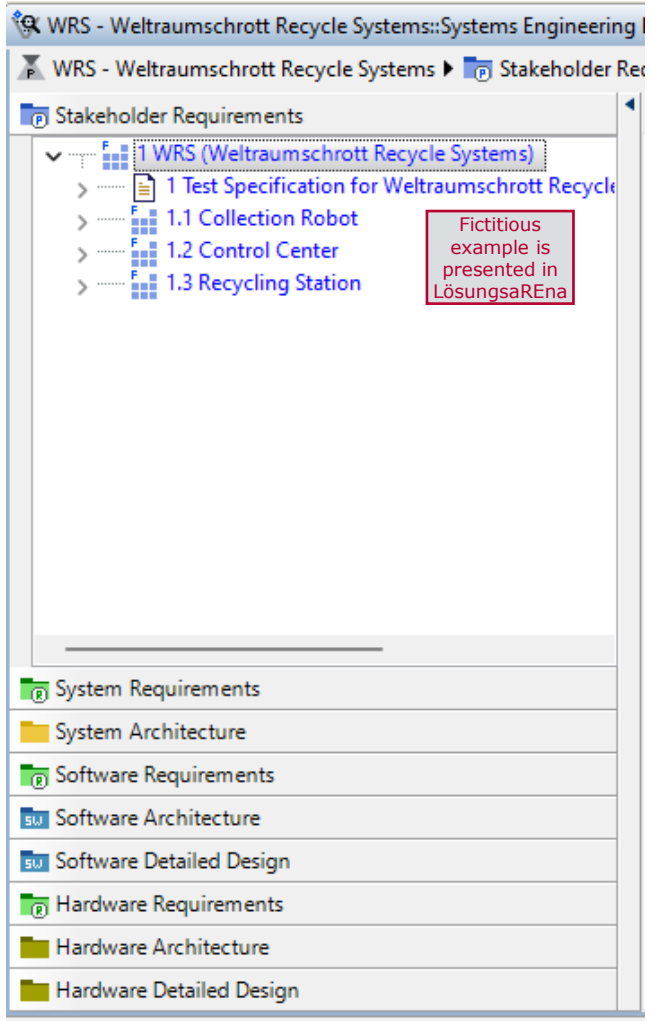
- PREEvision supports all processes except implementation steps (Step 7)

7

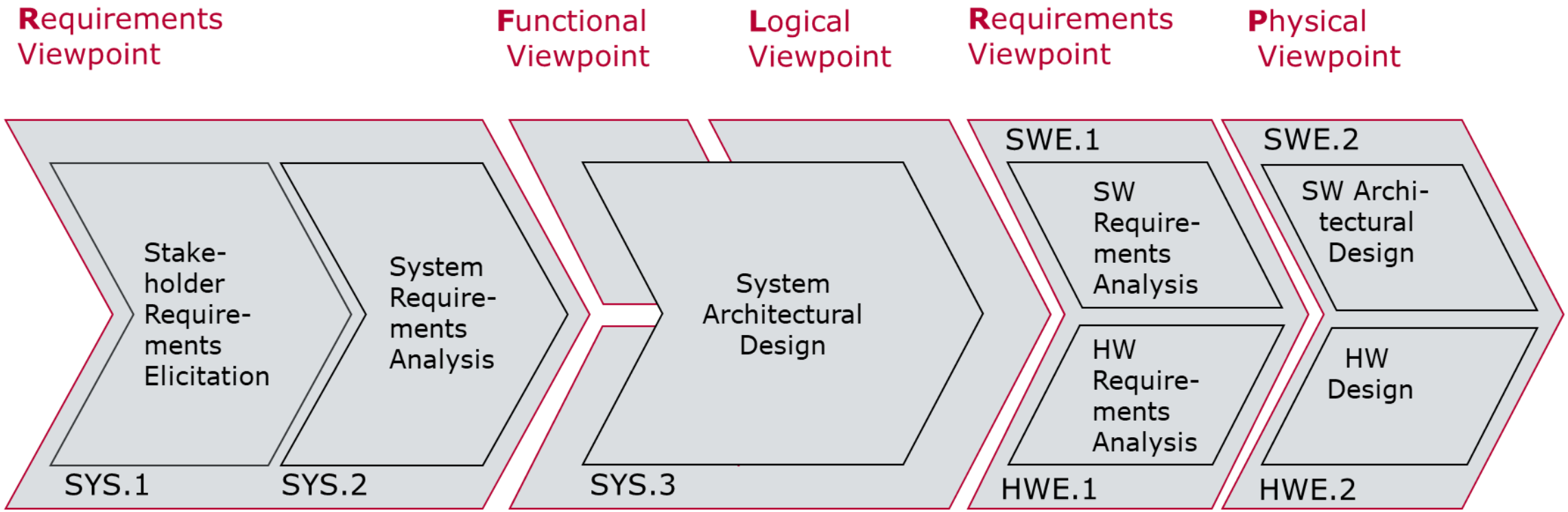
We Provide a Solution ready to Use

- … with a User Interface for these Processes

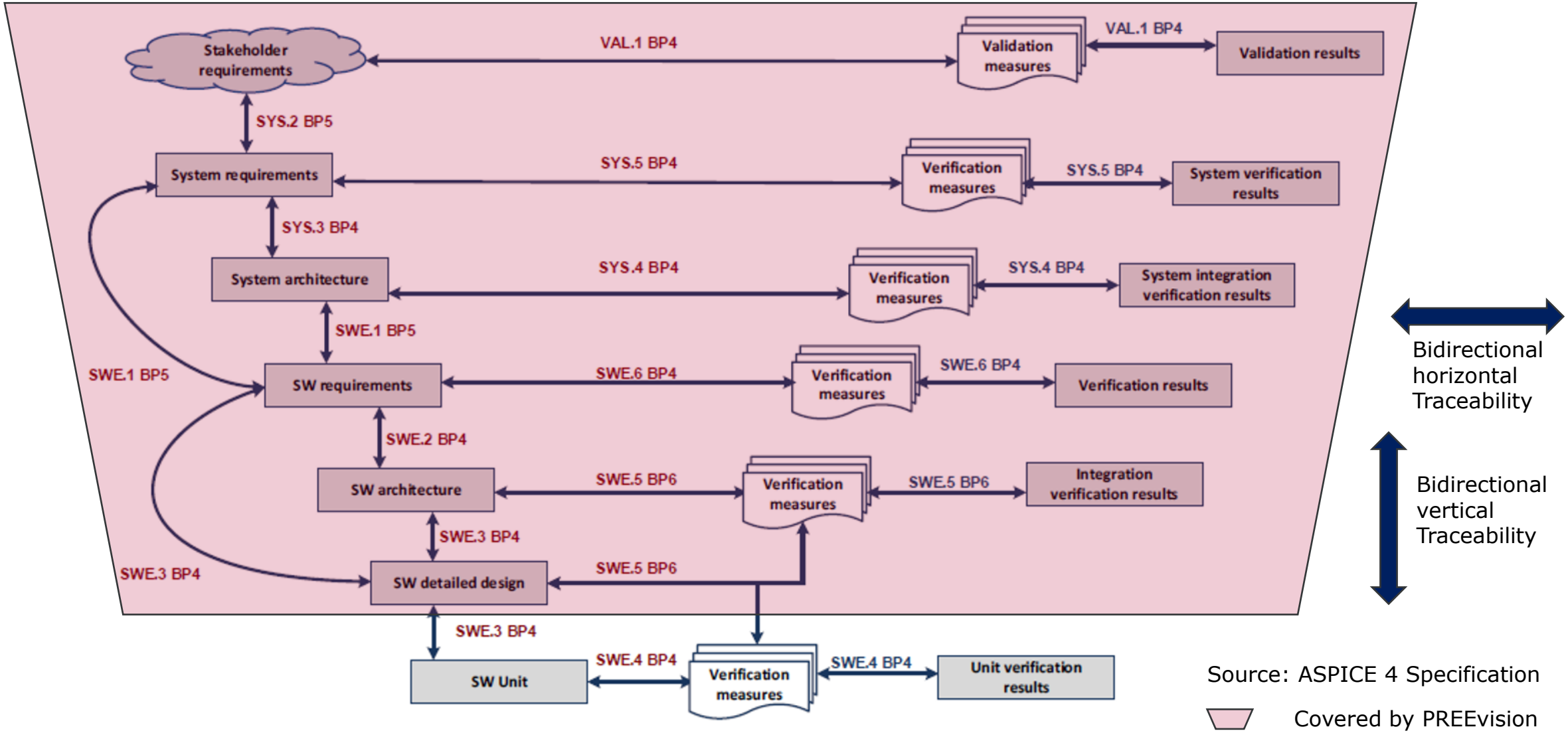




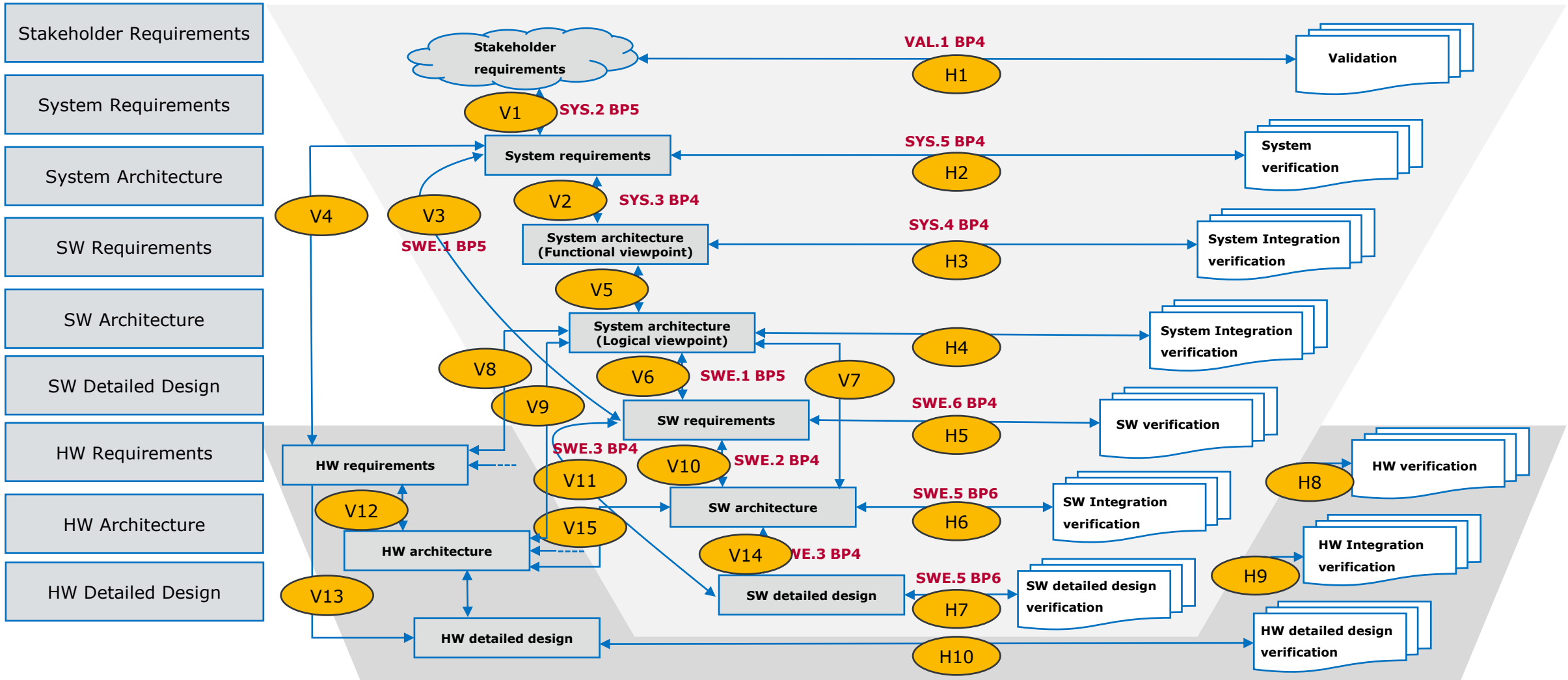
ASPICE and RFLP Are No Contradiction



Bidirectional Traceability for System and SW Processes



Traceability Overview



The Requirements Viewpoint is not limited to Text based Editors

- The Requirements Viewpoint is supported by text based and diagram-based editors

Relevant Explorer Categories:

- Stakeholder Requirements
- System / Software / Hardware Requirements

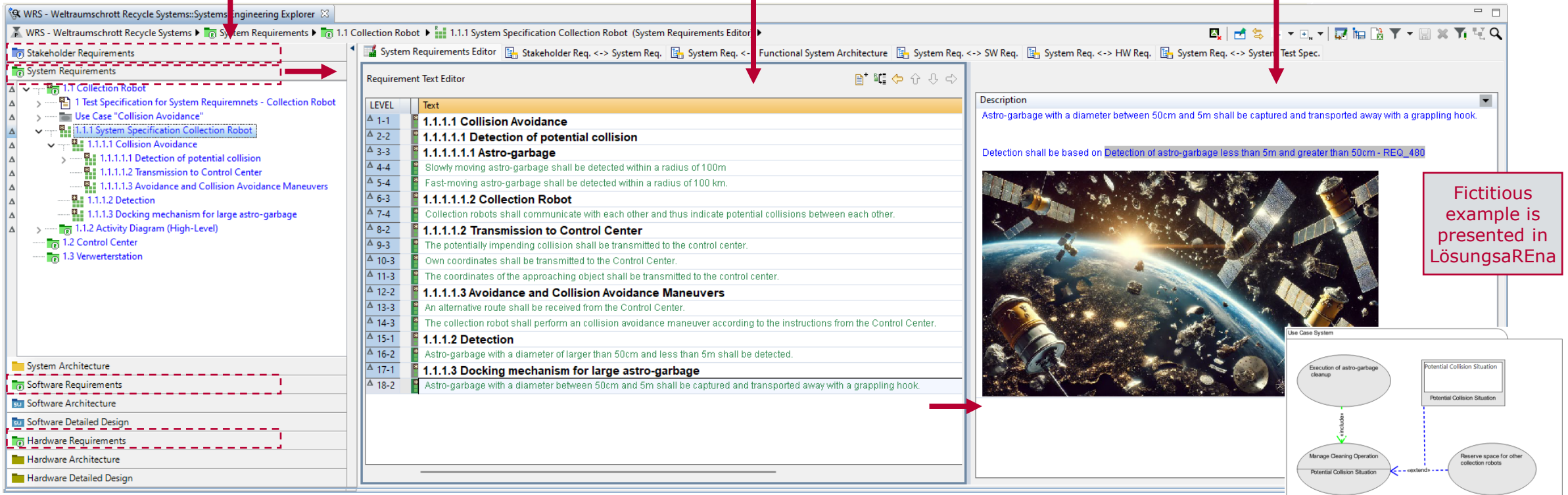
Requirements Editor for …

- System Requirements

… is selected and shows a compact representation of the system specification

Detailed description of the system requirement with …

- formatted text, inserted graphic and text placeholders



Fictitious example is presented in LösungsaREna

Test Specification Editor

Define Test Specification for e.g. System Requirements using …

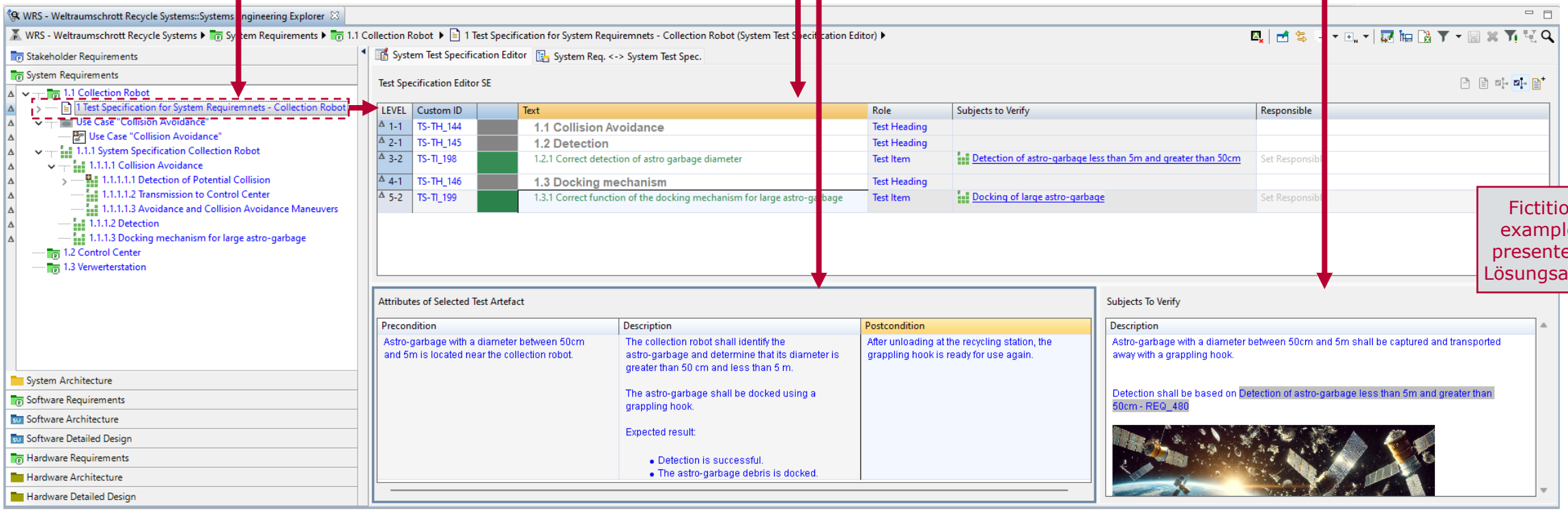
- Artifact Under Test

Test Specification:

- Specify the Test Items with Precondition / Description / Postcondition

Get a detailed overview about the Subjects to Verify. In this case for the …

- System Requirement



Fictitious example is presented in LösungsaREna

Vertical Traceability Editor

Explorer Categories:

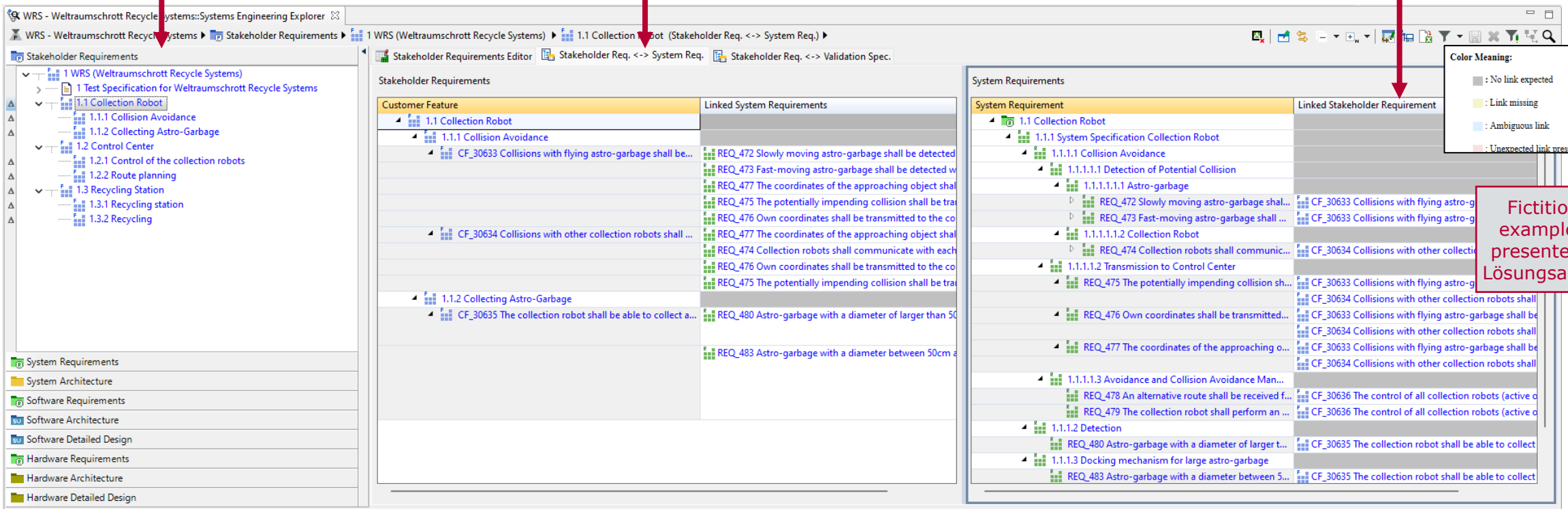
- Seamless from "Stakeholder Requirements" across "System Architecture" to "Software/Hardware Detailed Design"

Traceability Editor for …

- "Stakeholder Requirements ←→ System Requirements"

… is selected and shows vertical traceability

The user gets direct feedback through highlighting in the "Traceability Editors", e.g. missing traceability



Horizontal Traceability Editor

Explorer Categories:

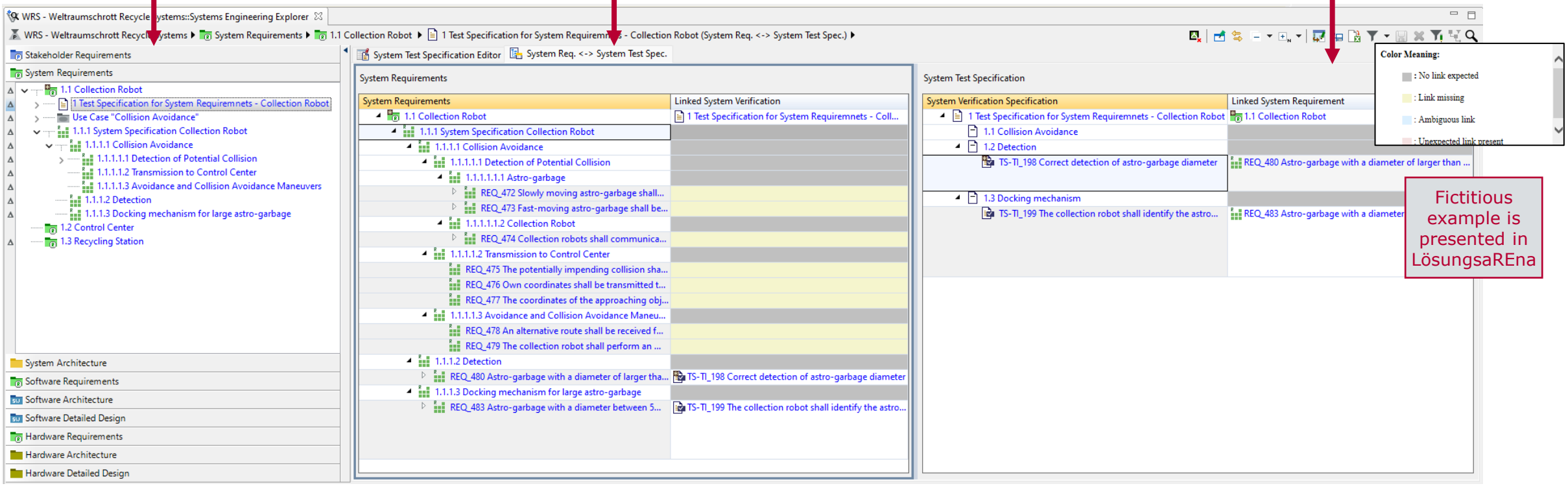
- Seamless from "Stakeholder Requirements" across "System Architecture" to "Software/Hardware Detailed Design"

Traceability Editor for …

- "System Requirements ←→ System Test Spec"

… is selected and shows horizontal traceability

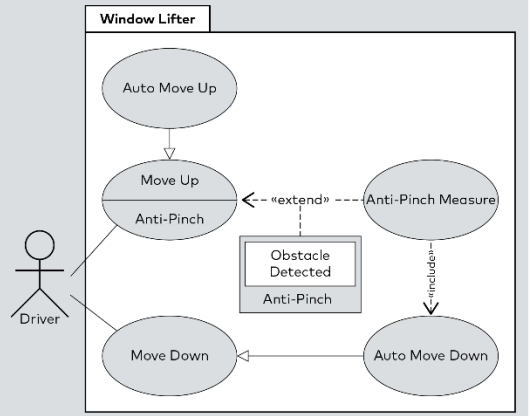
The user gets direct feedback through highlighting in the "Traceability Editors", e.g. missing traceability



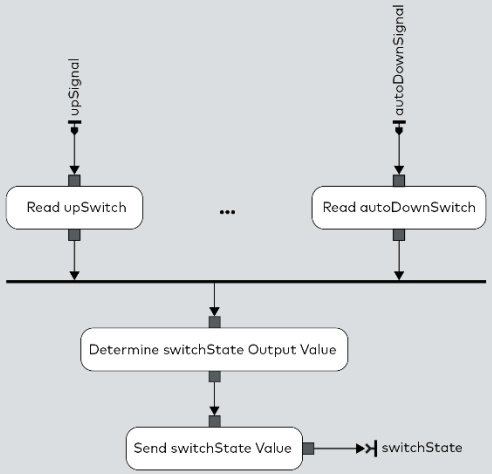
All needed SysML Concepts are available

Behavior Diagrams

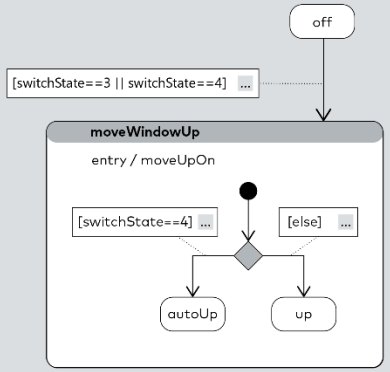
Use Case Diagram



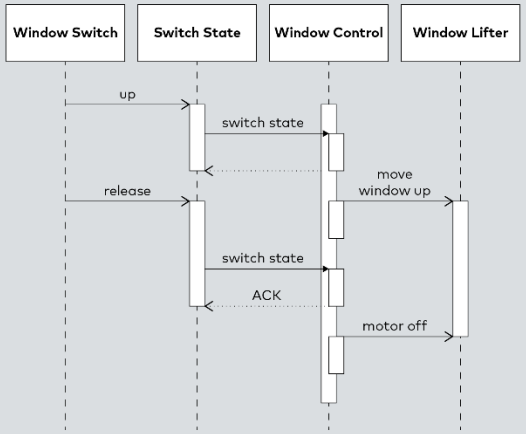
Activity Diagram



State Machine Diagram

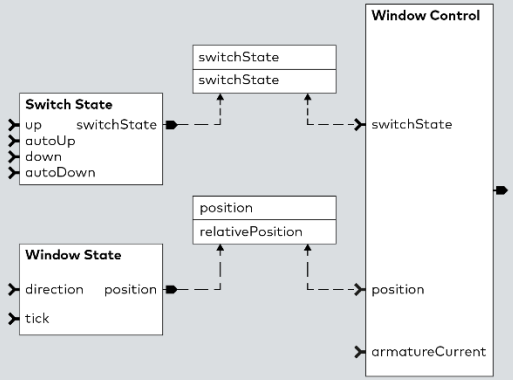


Sequence Diagram

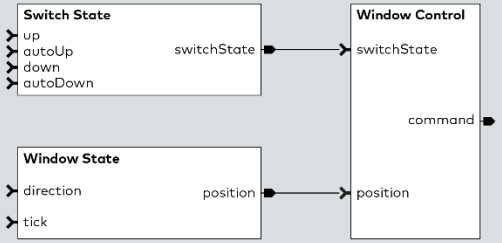


Structure Diagrams

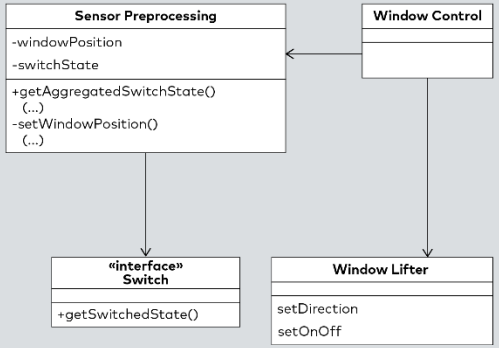
Block and Interface Definition Diagram



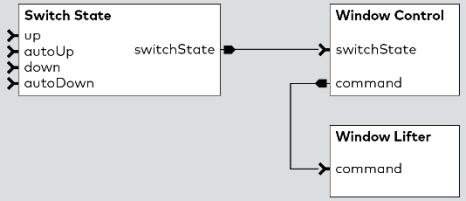
Logical Architecture Diagram



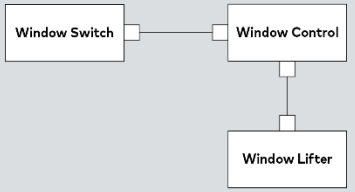
Class Diagram



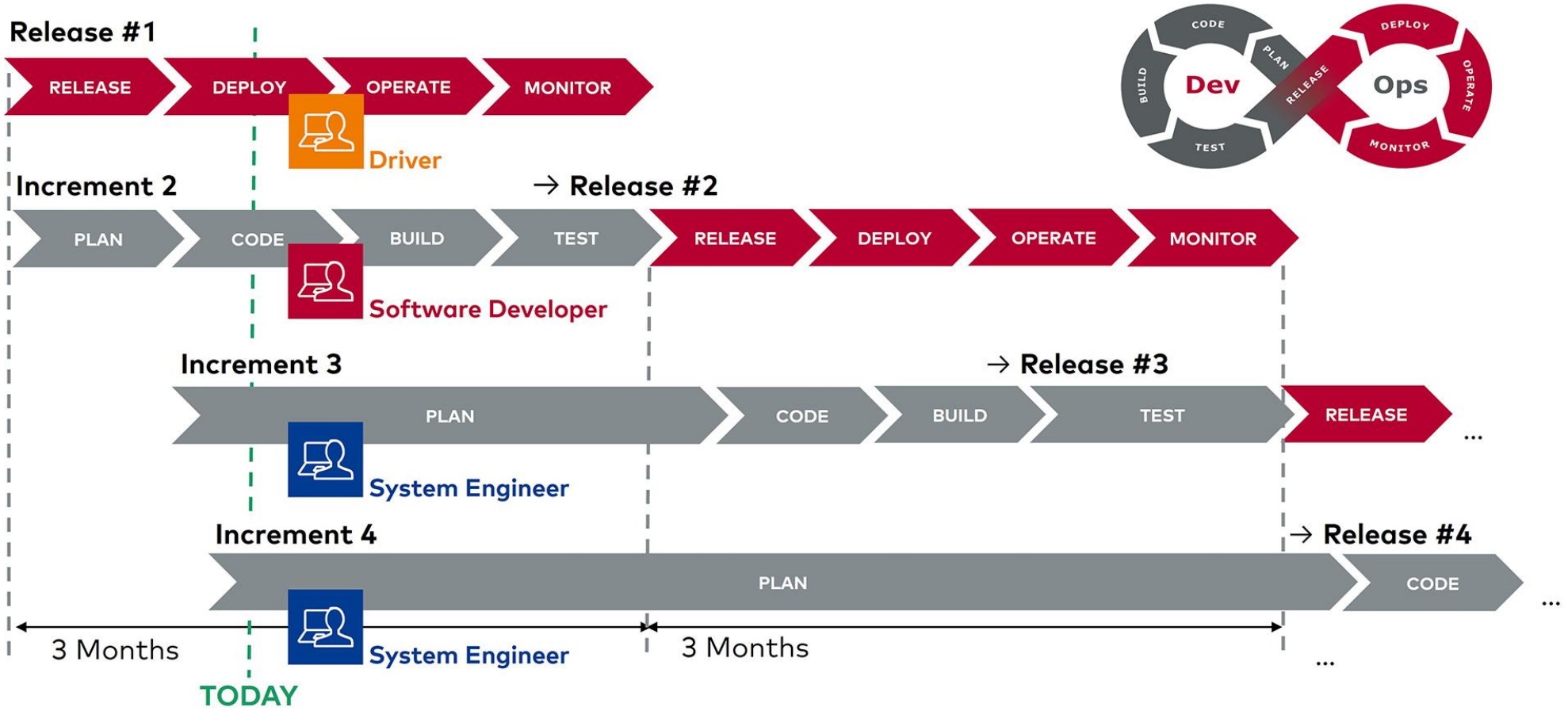
Software Diagram



Hardware Network Diagram



Parallel and Agile Work on Different Releases is supported



Baselining, Release Branches and Development Pipelines are mandatory not only in Software Development, but also for Systems Engineering! PREEvision provides the needed functionality.

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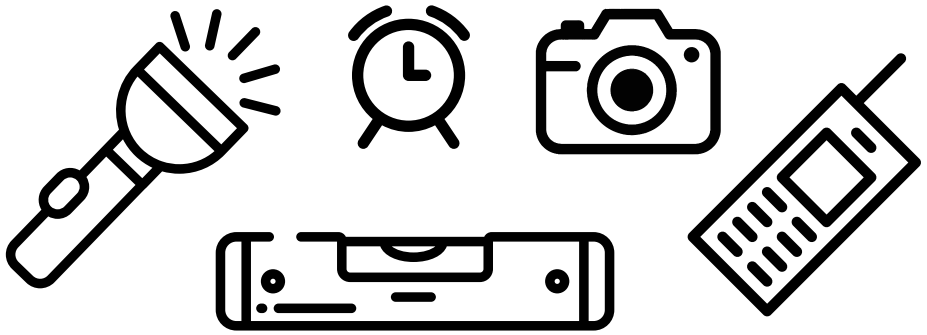
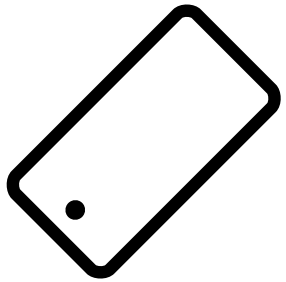
Tools – Integrated or Not?



- Cell Phone
- Camera
- Flashlight
- Alarm Clock
- Level
- …



Requirements Management Tool

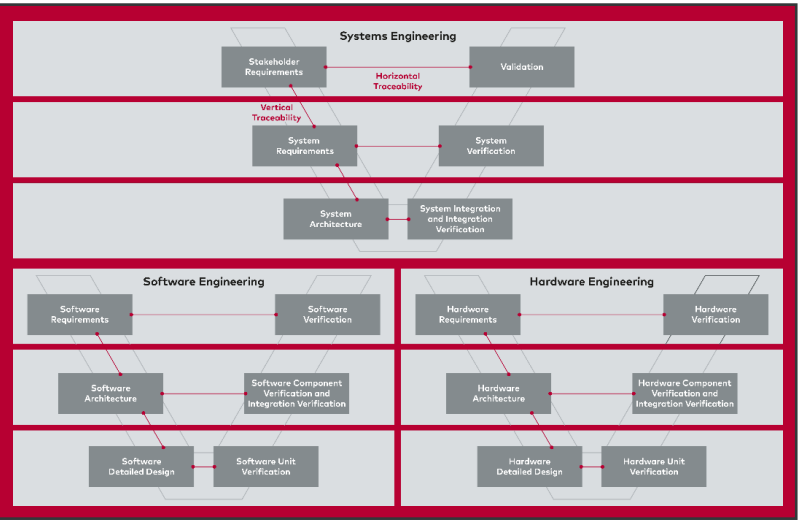
Variant Management Tool

SysML Tool

Traceability Tool

"Best in Class"

Integrated Tool



"Best Convenience, Consistency and Transparency"

Your Questions are Welcome!

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