DSC 2023

Special Session
ADAS / AD validation process targeting homologation

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Reference Homologation Process

Jürgen Niehaus

SafeTRANS
SAFETY IN TRANSPORTATION SYSTEMS

ECSEL
Joint Undertaking

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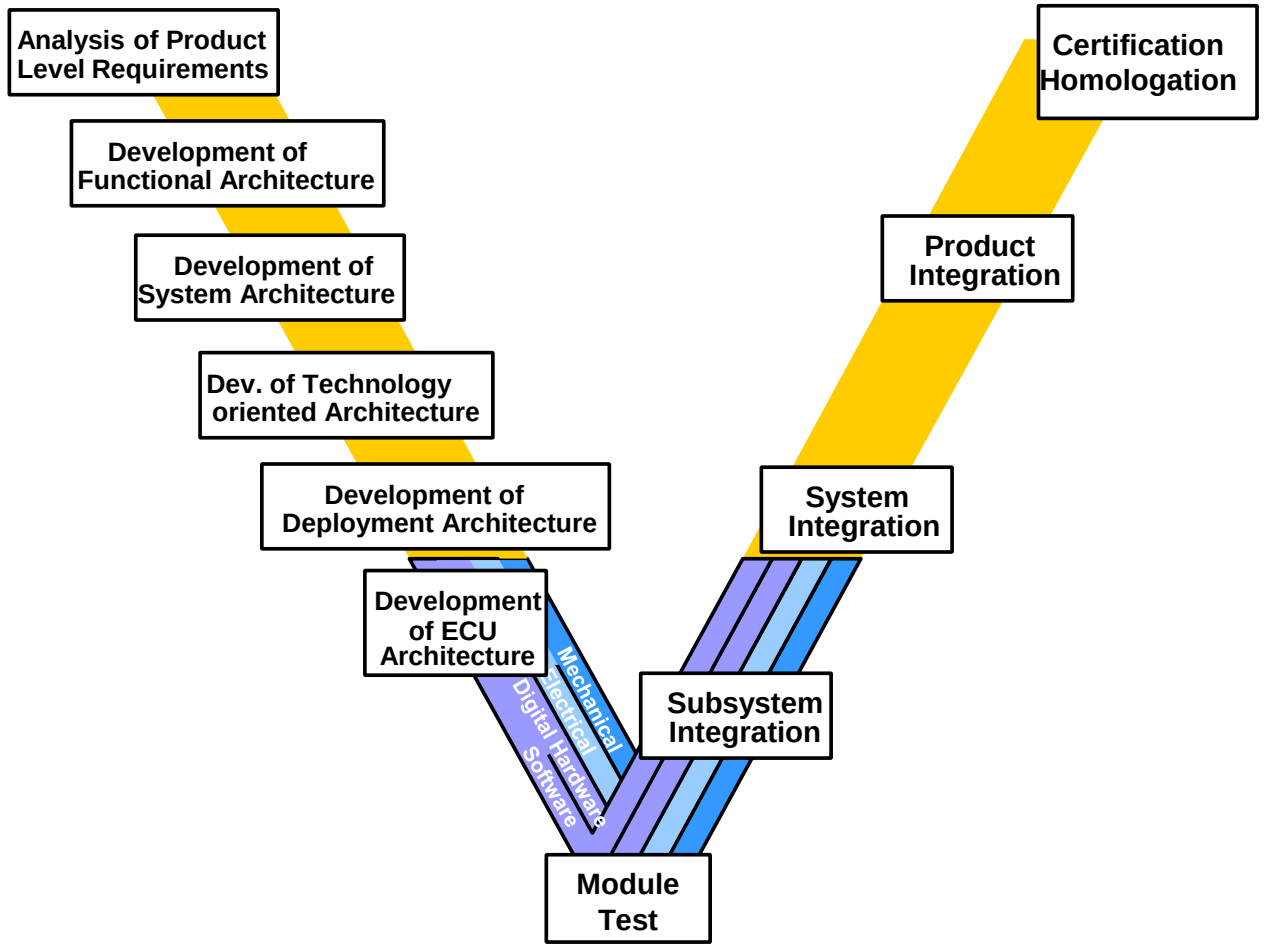
- Mapping Technology Bricks
  - Pegasus Family – Safety Analysis and Argumentation
  - Step-UP!CPS / AutoDevSafeOps – OTA Updates
  - ArchitectECA 2030 – Safety Architecture and Online-Monitoring
- Homologation
  - Regulations, Standards and Challenges

Reference Homologation Process



- Process description covering typical steps to
  - develop (design, implement, integrate)
  - validate (analyze, simulate, test, verify,…)
- Based on V-Model
- Model based, hierarchical design
  - System – Subsystems – Components – Modules
- Each step/substep defines ‚Design Artefacts‘ and the way in which they are created resp. tranformed.
- As a reference, not as a mandatory obligation

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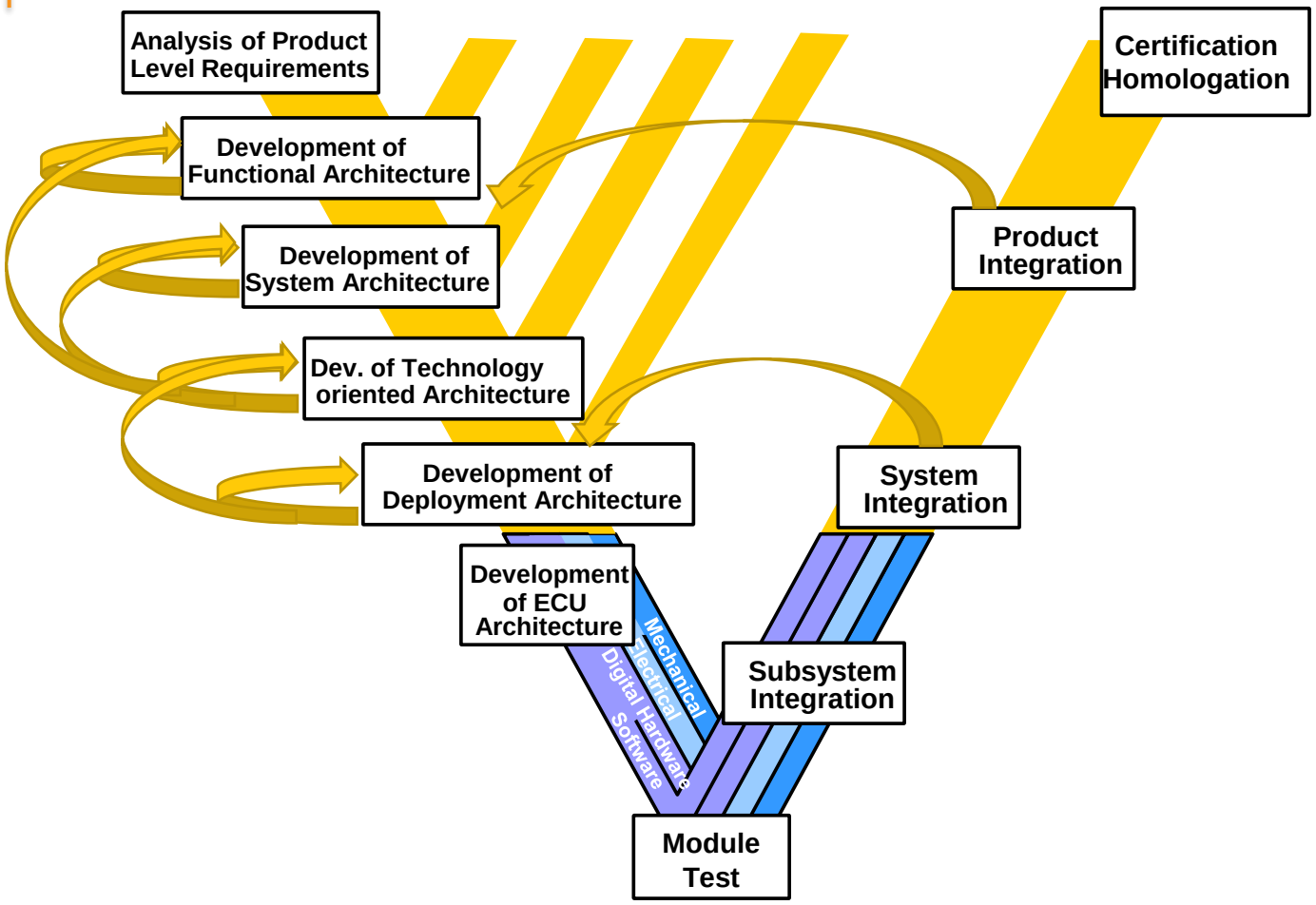

- For sake of clarity *in the pictures* wie ommit
  - Iterations, loops, backtracking,…
  - Early (prototype) integration and test (‚executable models‘)
  - Development for specific target architectures,…
  - Data bases, Libraries,…
  - …

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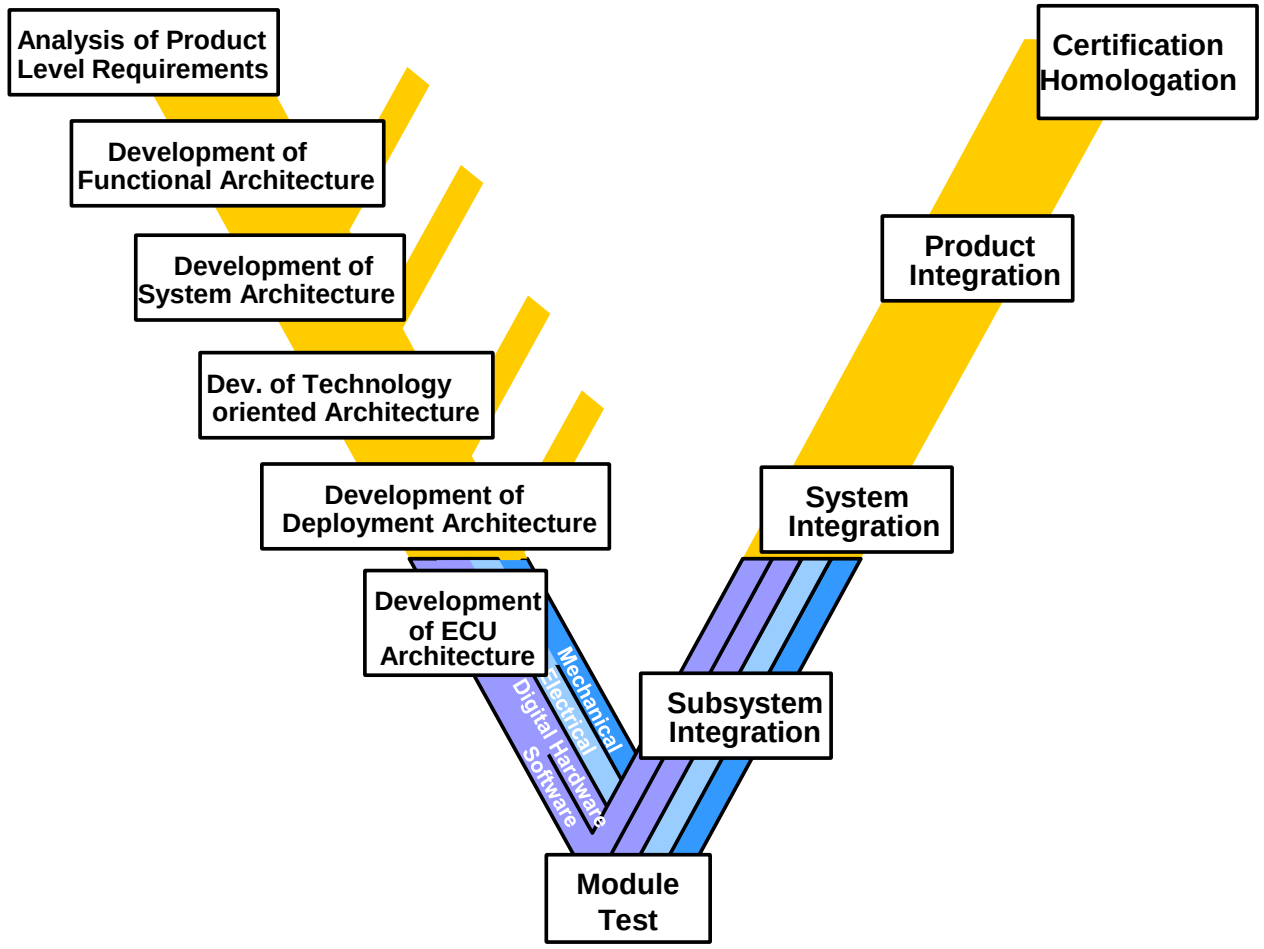

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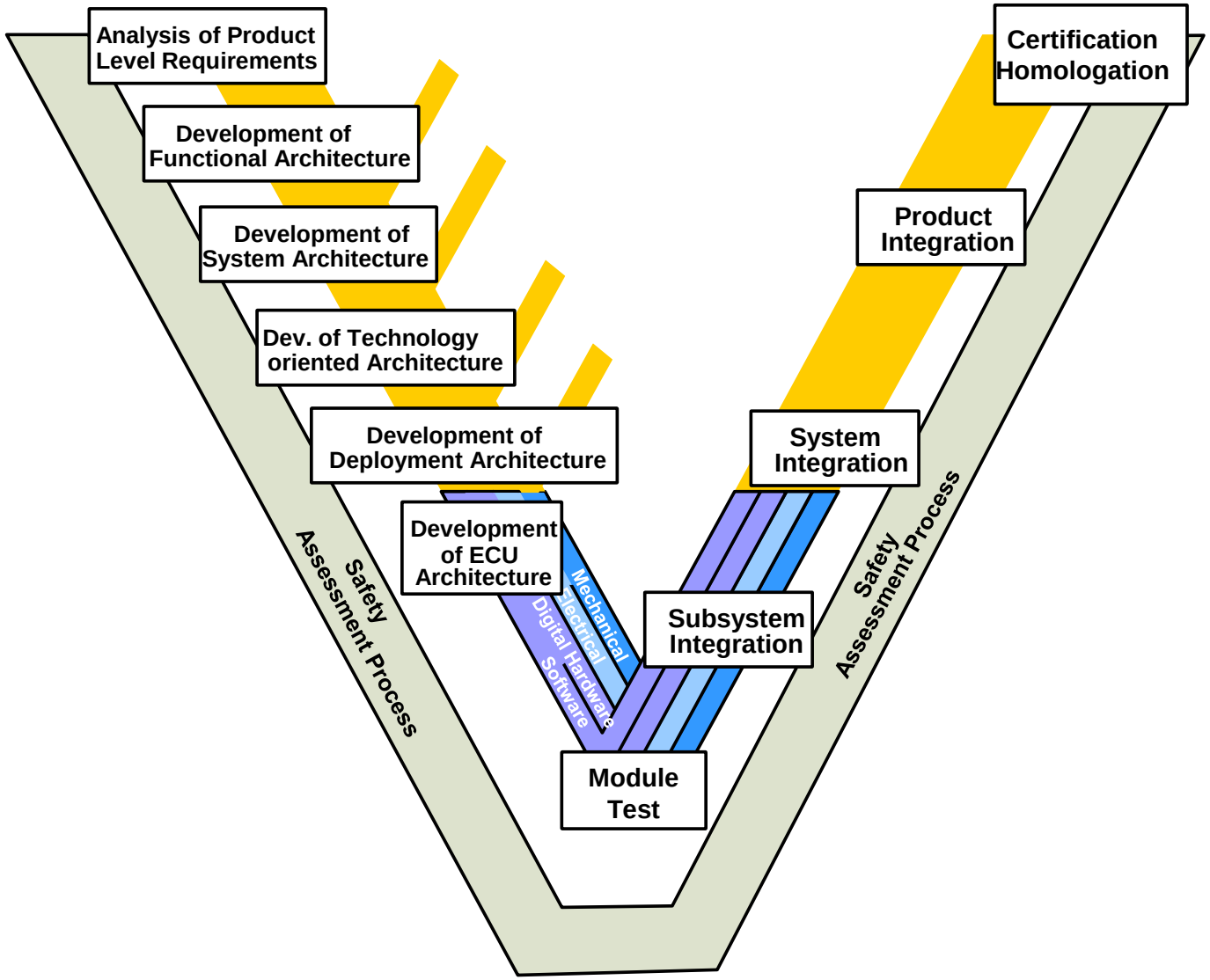

Safety Assessment Process

- Set-up Safety Assurance Case(s)
  - Structured Argument
  - CAE: Claims – Arguments -- Evidence
- Claims: Based on Product Level Requirements and Product Capabilities
- Evidence: Typically derived
  - deductively from Safety Architecture and from formal Verification
  - empirically from Testing, Simulation,..

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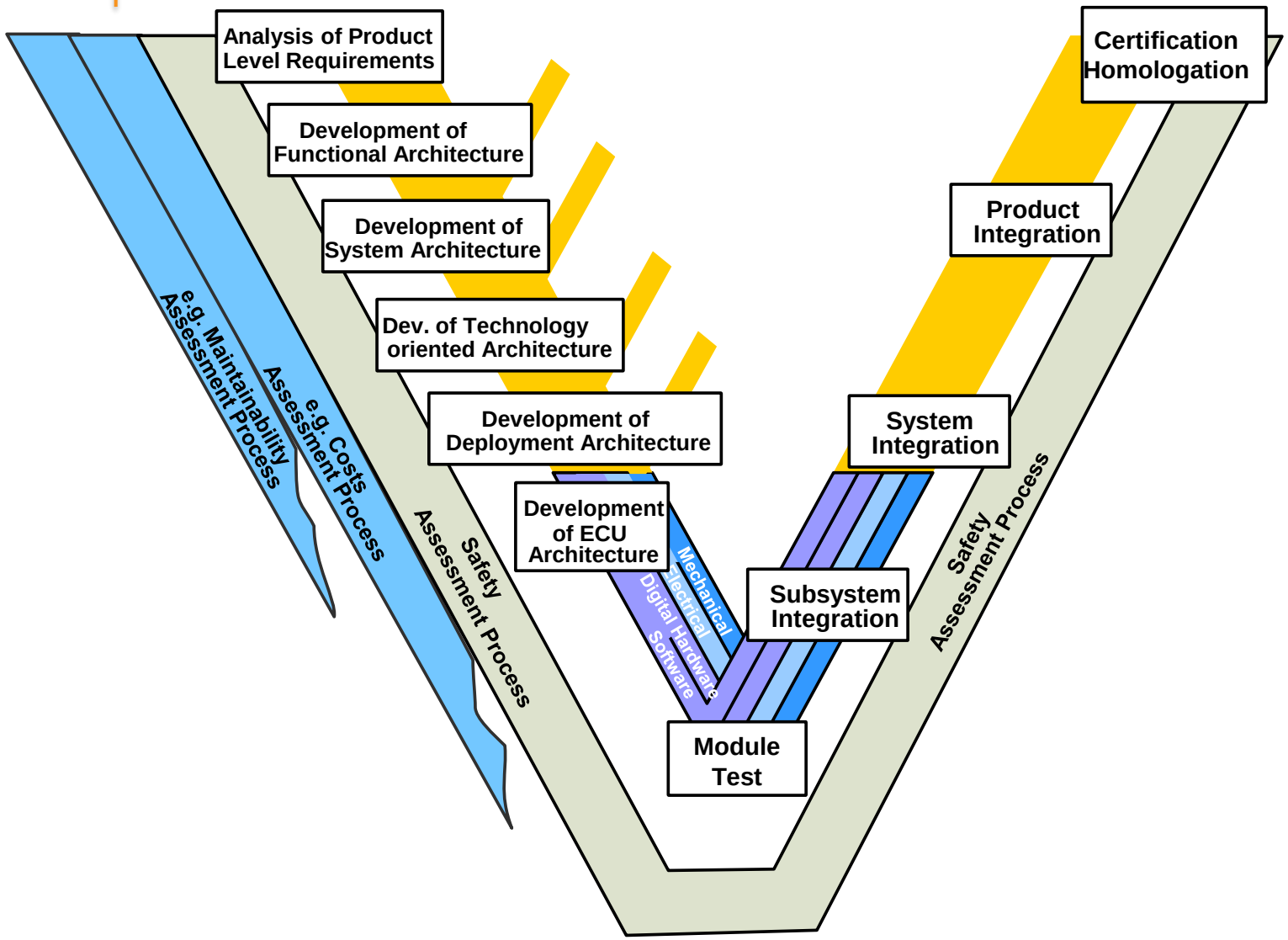

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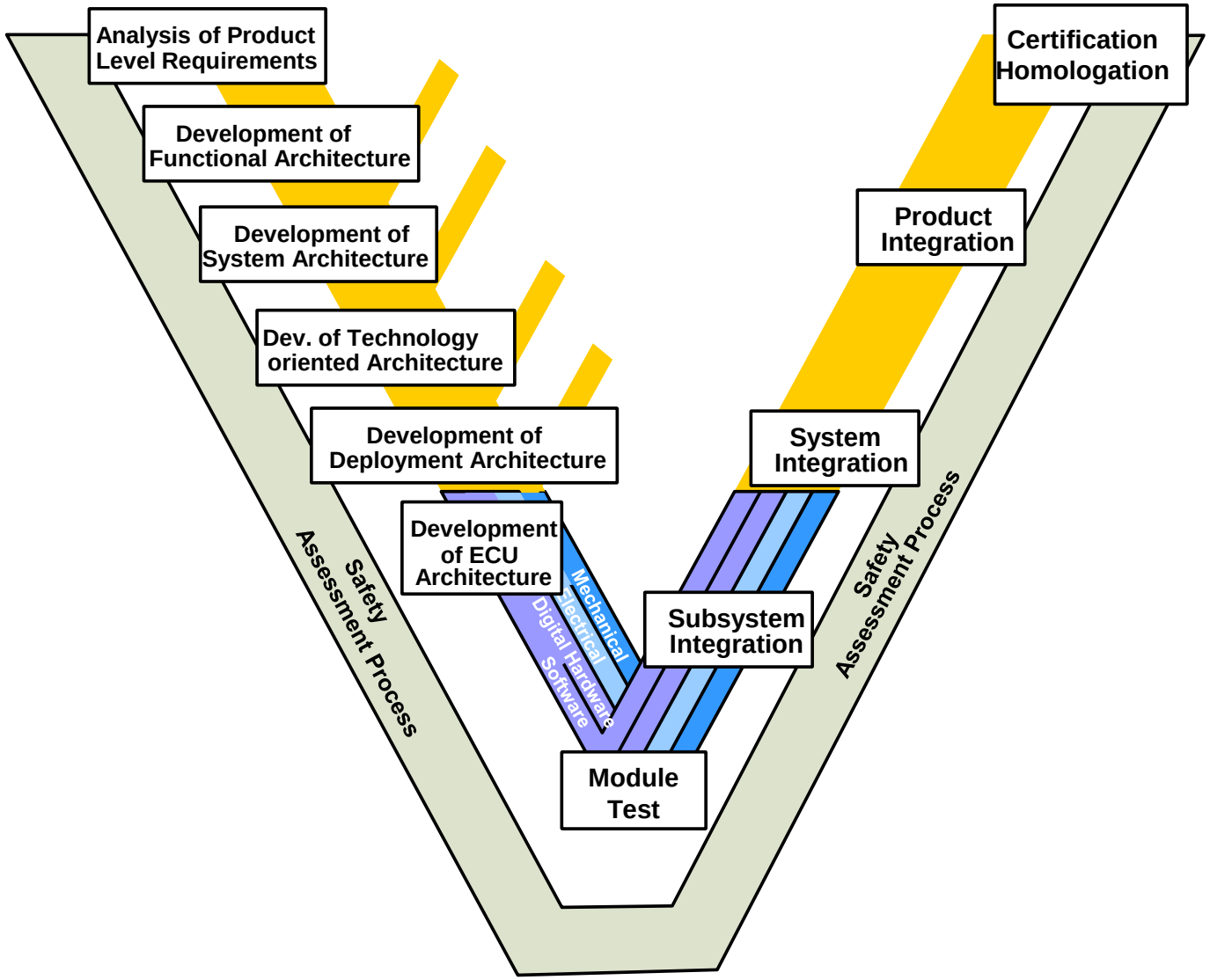
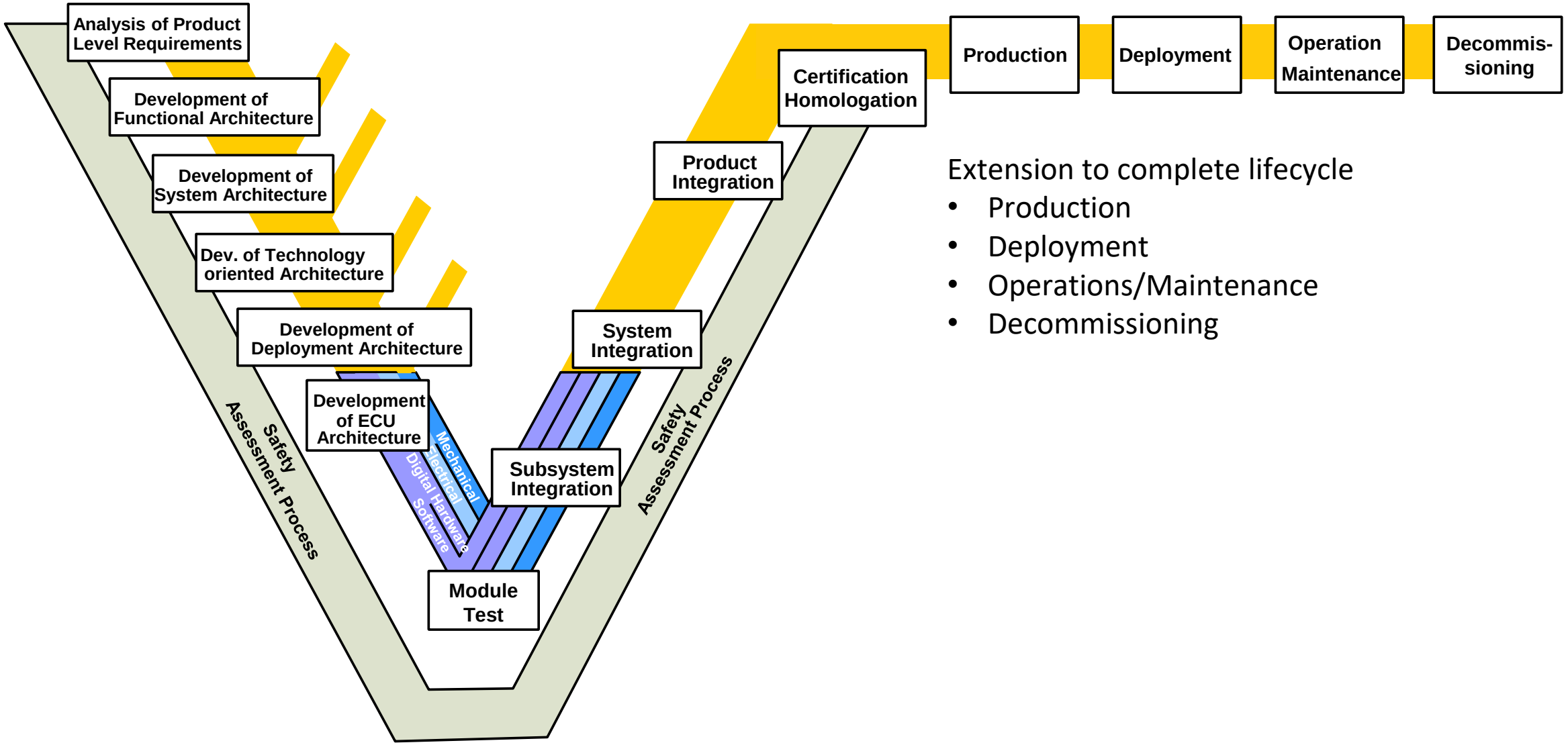


Reference Homologation Process

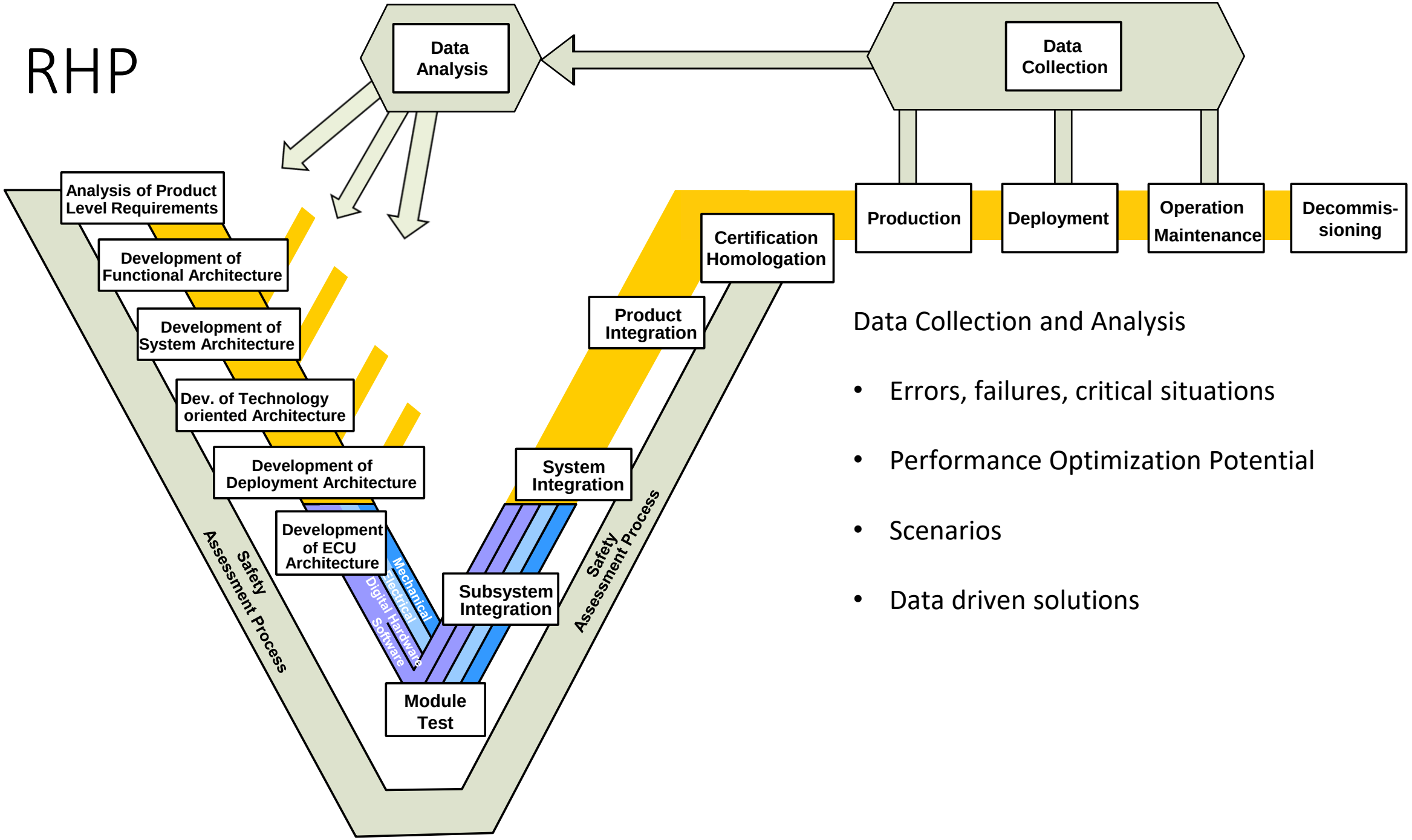
a.k.a. Reference Lifecycle Process



Extension to complete lifecycle

- Production
- Deployment
- Operations/Maintenance
- Decommissioning

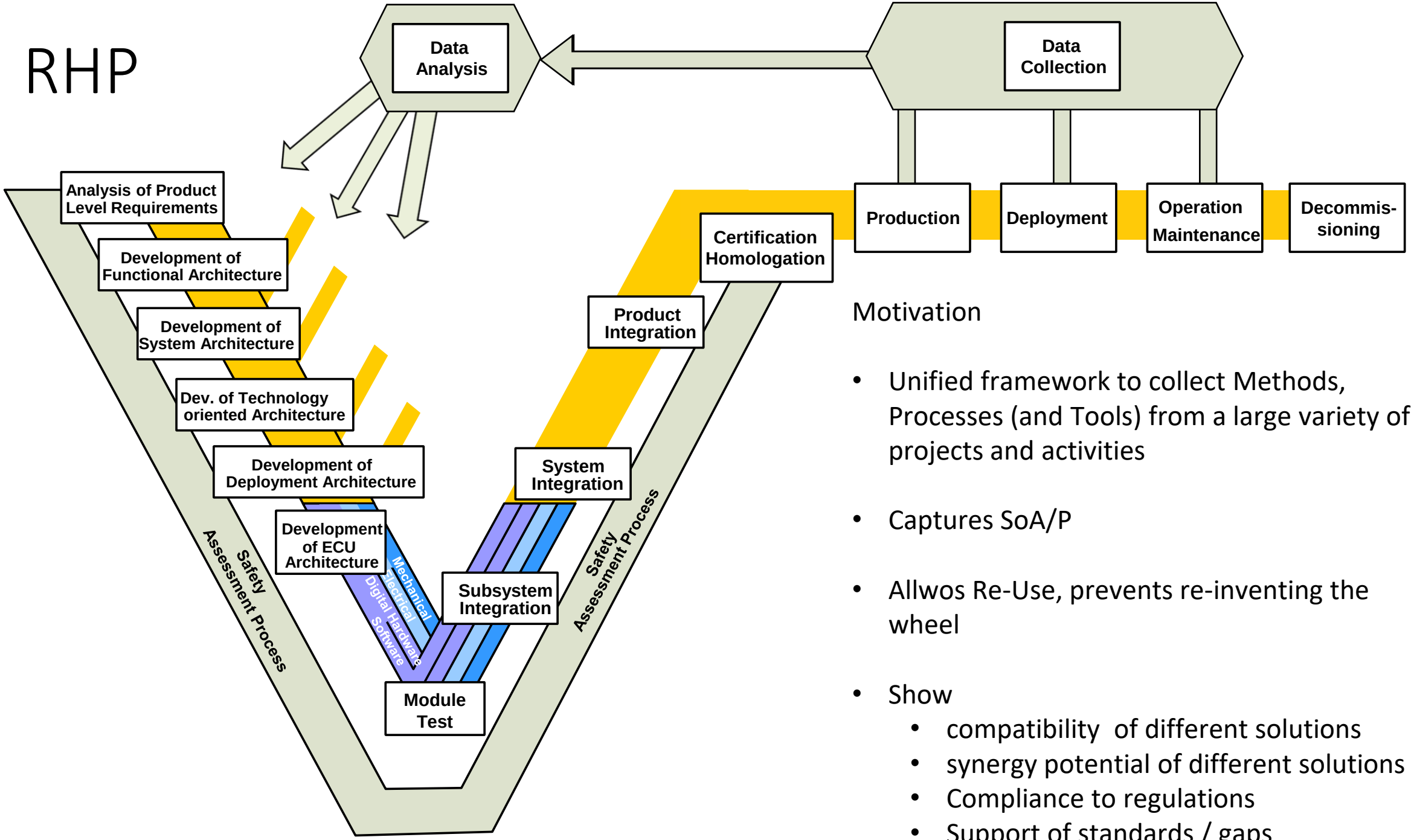
RHP



Data Collection and Analysis

- Errors, failures, critical situations
- Performance Optimization Potential
- Scenarios
- Data driven solutions

RHP

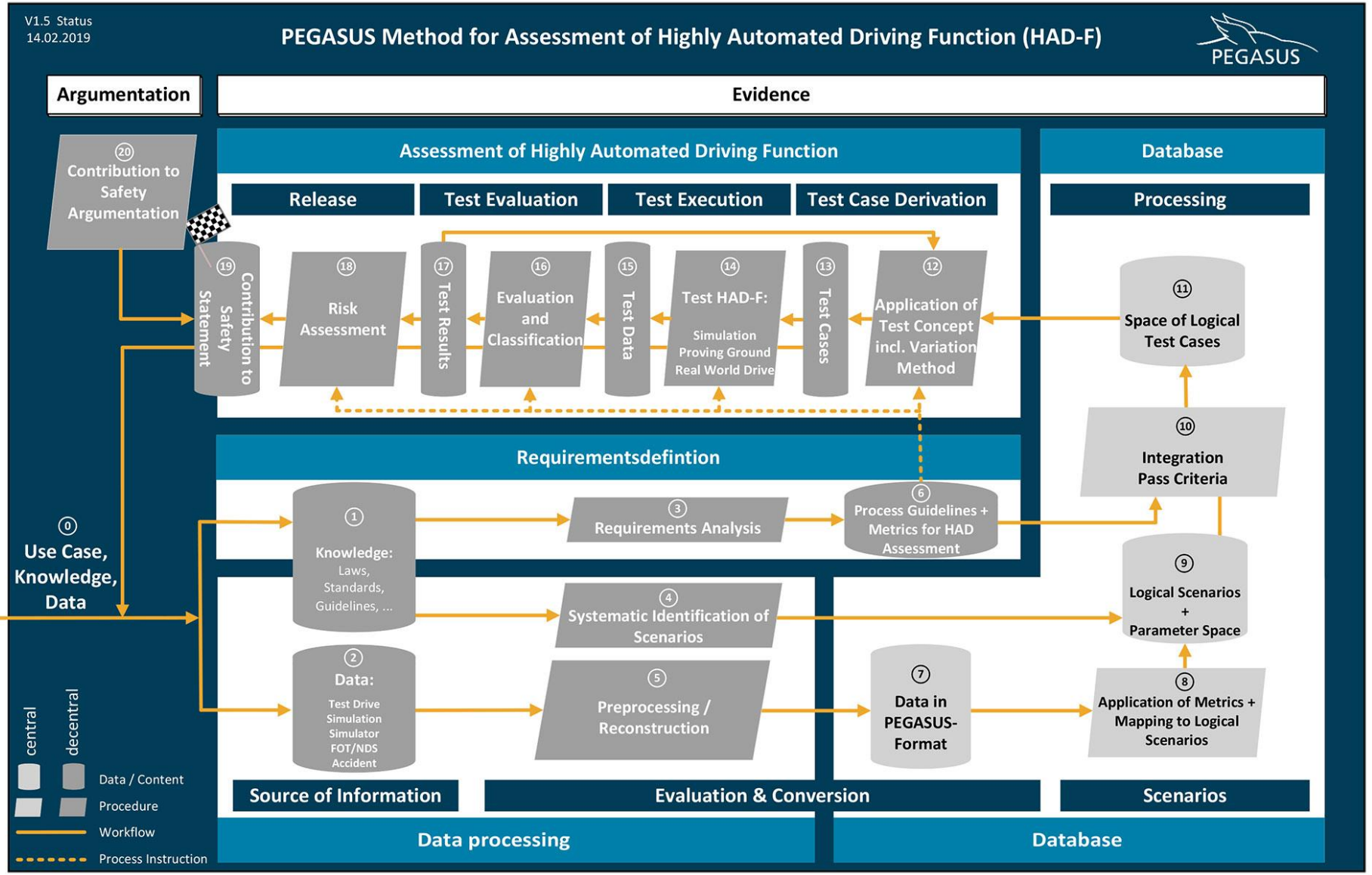


Motivation

- Unified framework to collect Methods, Processes (and Tools) from a large variety of projects and activities
- Captures SoA/P
- Allwos Re-Use, prevents re-inventing the wheel
- Show
  - compatibility of different solutions
  - synergy potential of different solutions
  - Compliance to regulations
  - Support of standards / gaps

Mapping Technology Bricks

Pegasus – Scenario based Assessent of HAD-F



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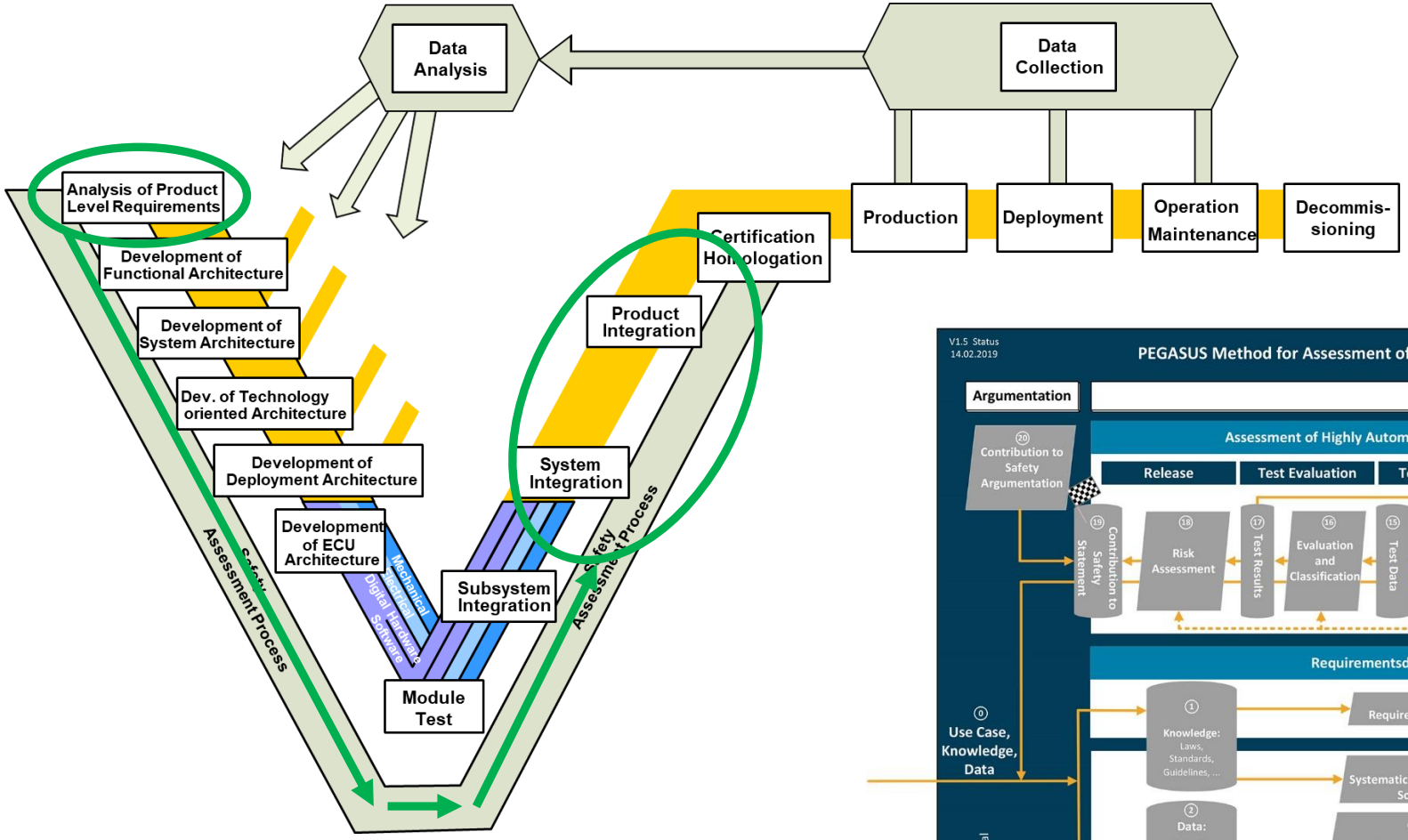
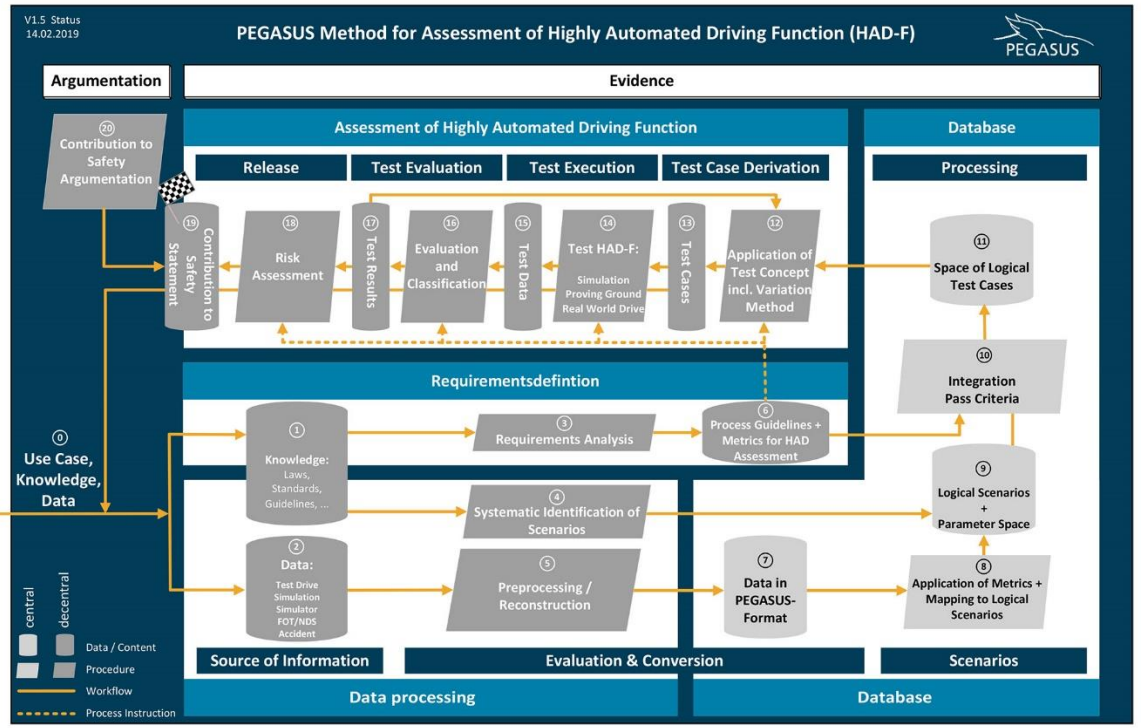
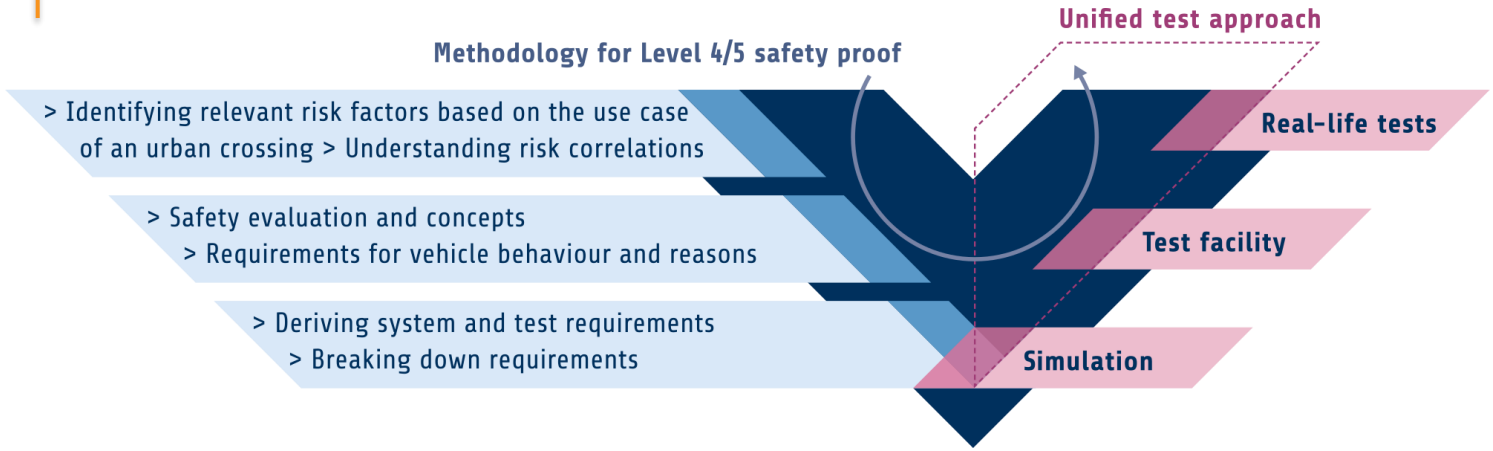
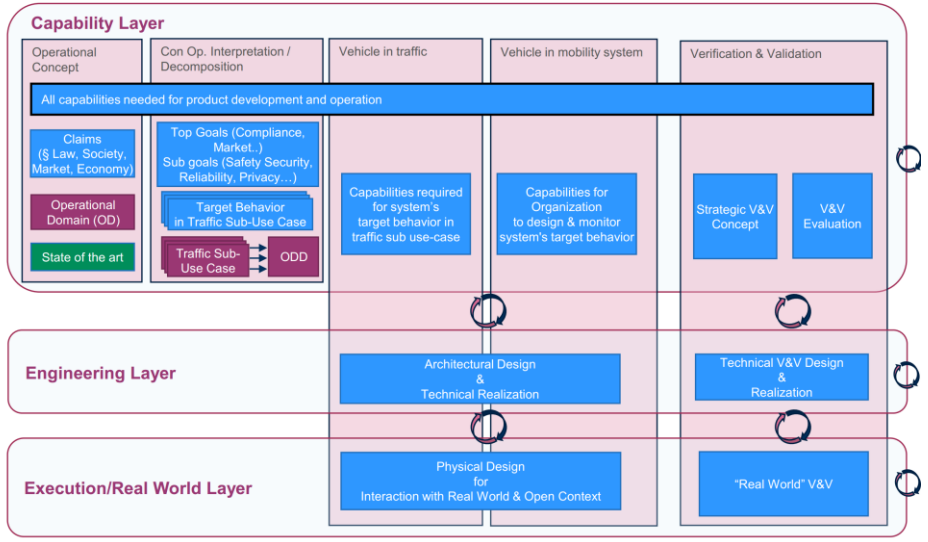




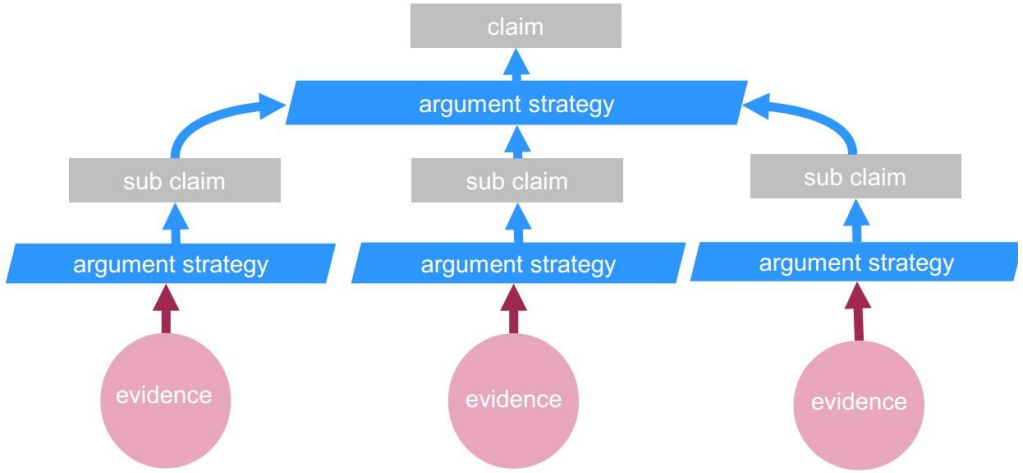
Mapping Technology Bricks

VVM – Methodology for Level 4/5 Safety Proof



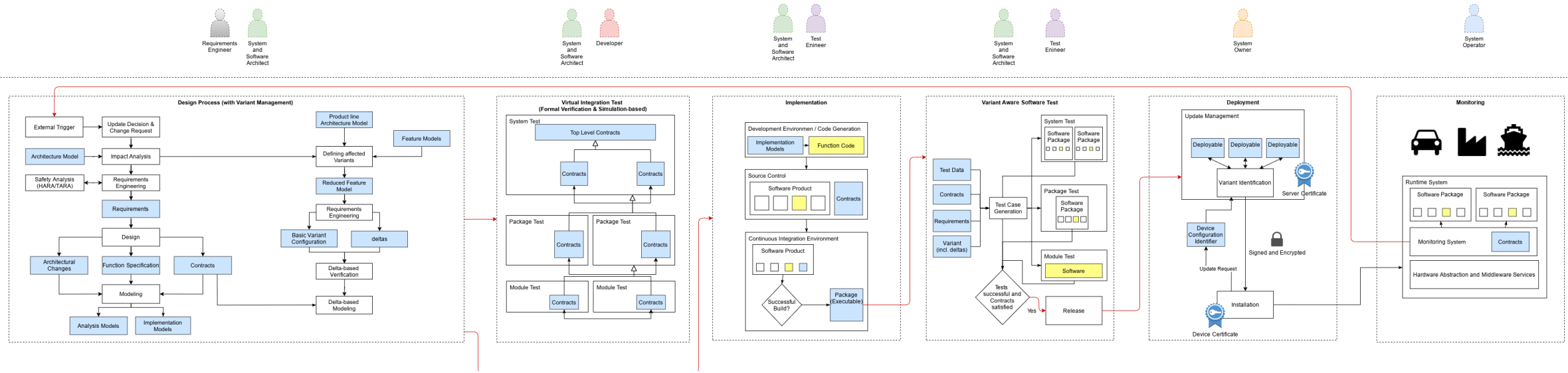


- Identify risk factors
- Test requirements based on
  - Use-Case / ODD
  - System/product requirements
  - Vehicle behavior and reasons
- Validation methodology across all system levels
- Unified test approach (deriving evidences) from simulation to real wolrd driving



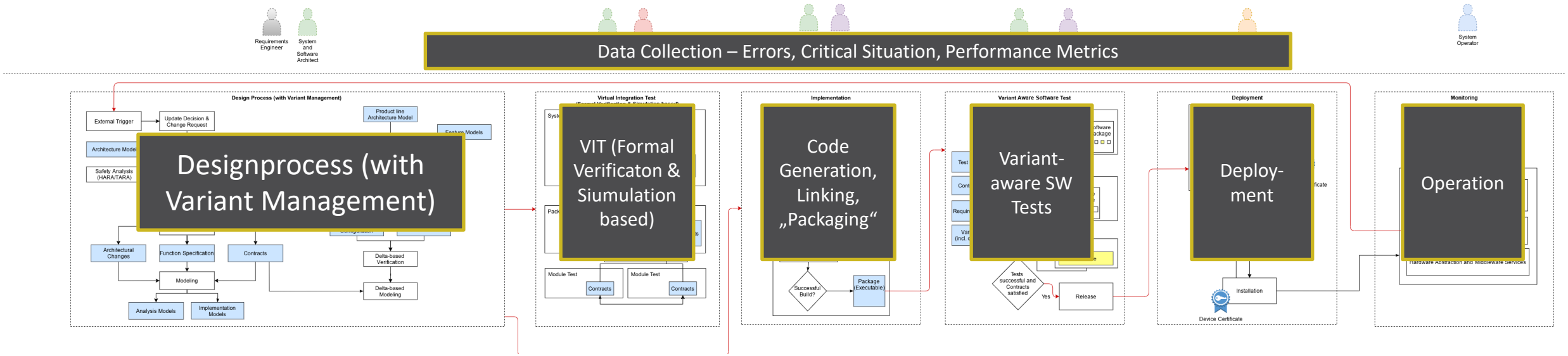
Mapping Technology Bricks

StepUp!CPS – OTA Updates (and Variants)



Mapping Technology Bricks

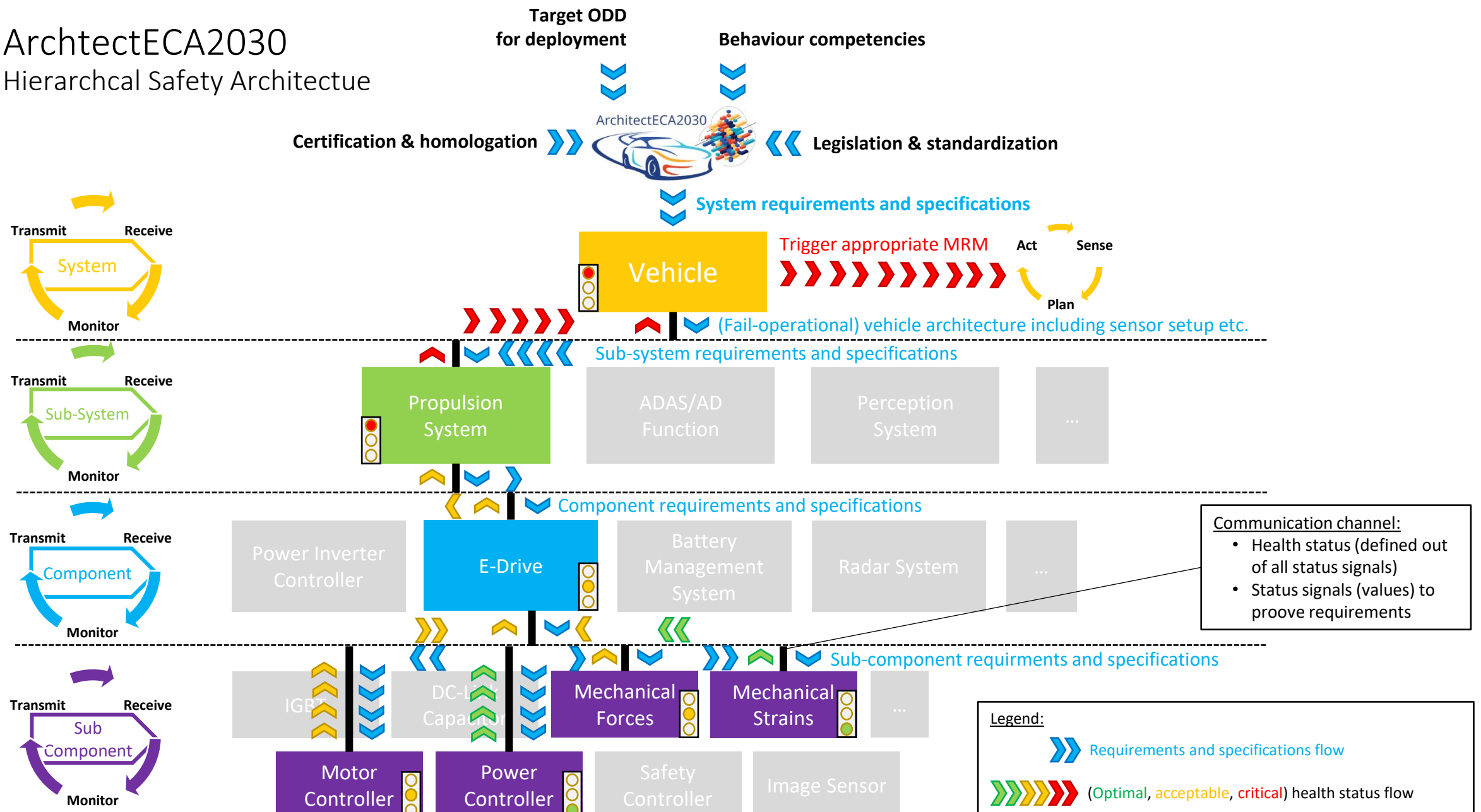
StepUp!CPS – OTA Updates (and Variants)



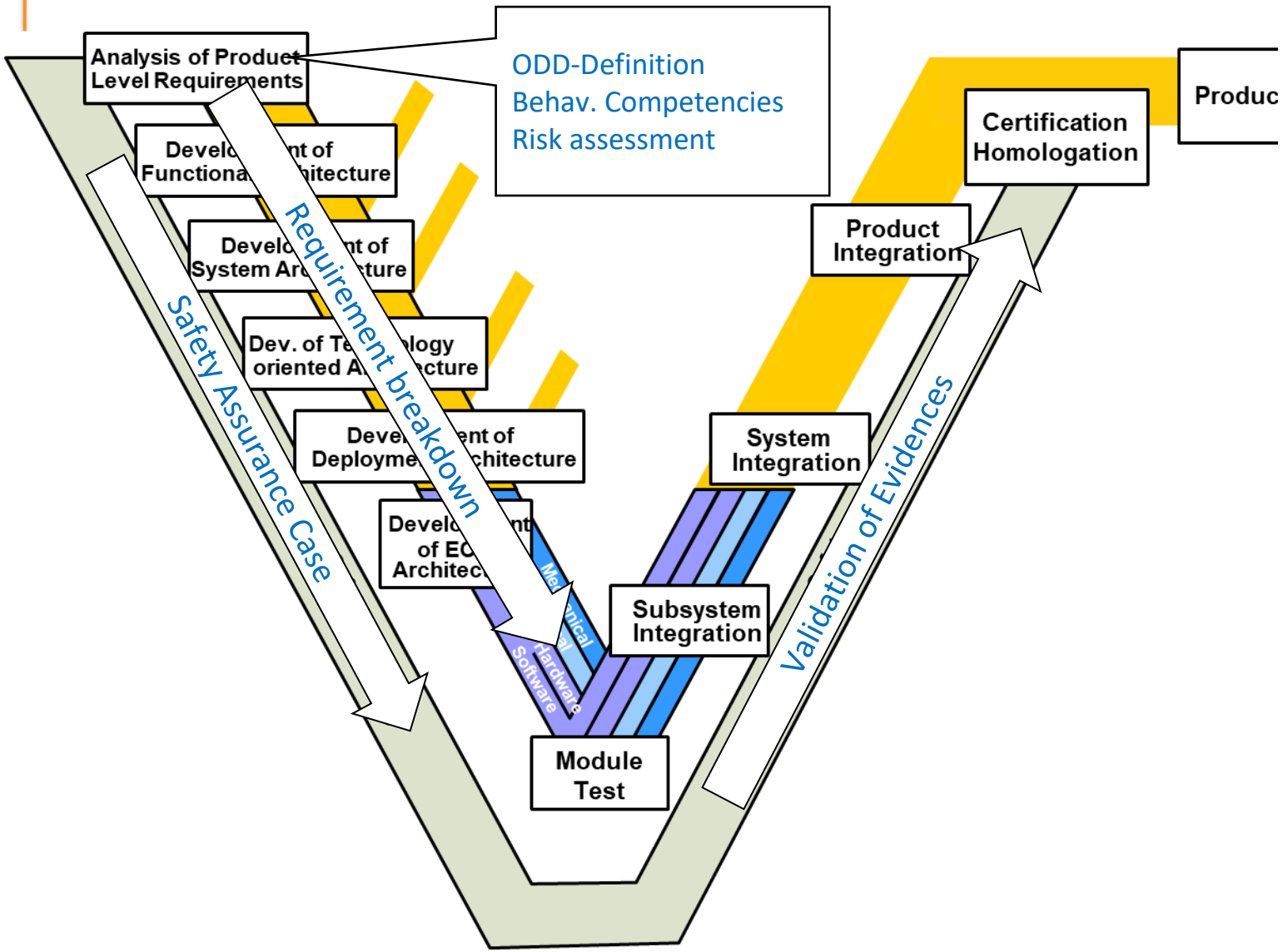
- Over-the-Air (Software) Updates require
  - Data collection (Errors and critical situaitons; performance data)
  - Virtual Integration Testing / Validation (based on contracts)
  - Safe (and secure) Deployment
  - …
- Variants require
  - Variant aware (‚delta-based‘) Validation and Test

ArchtectECA2030

Hierarchcal Safety Architectue

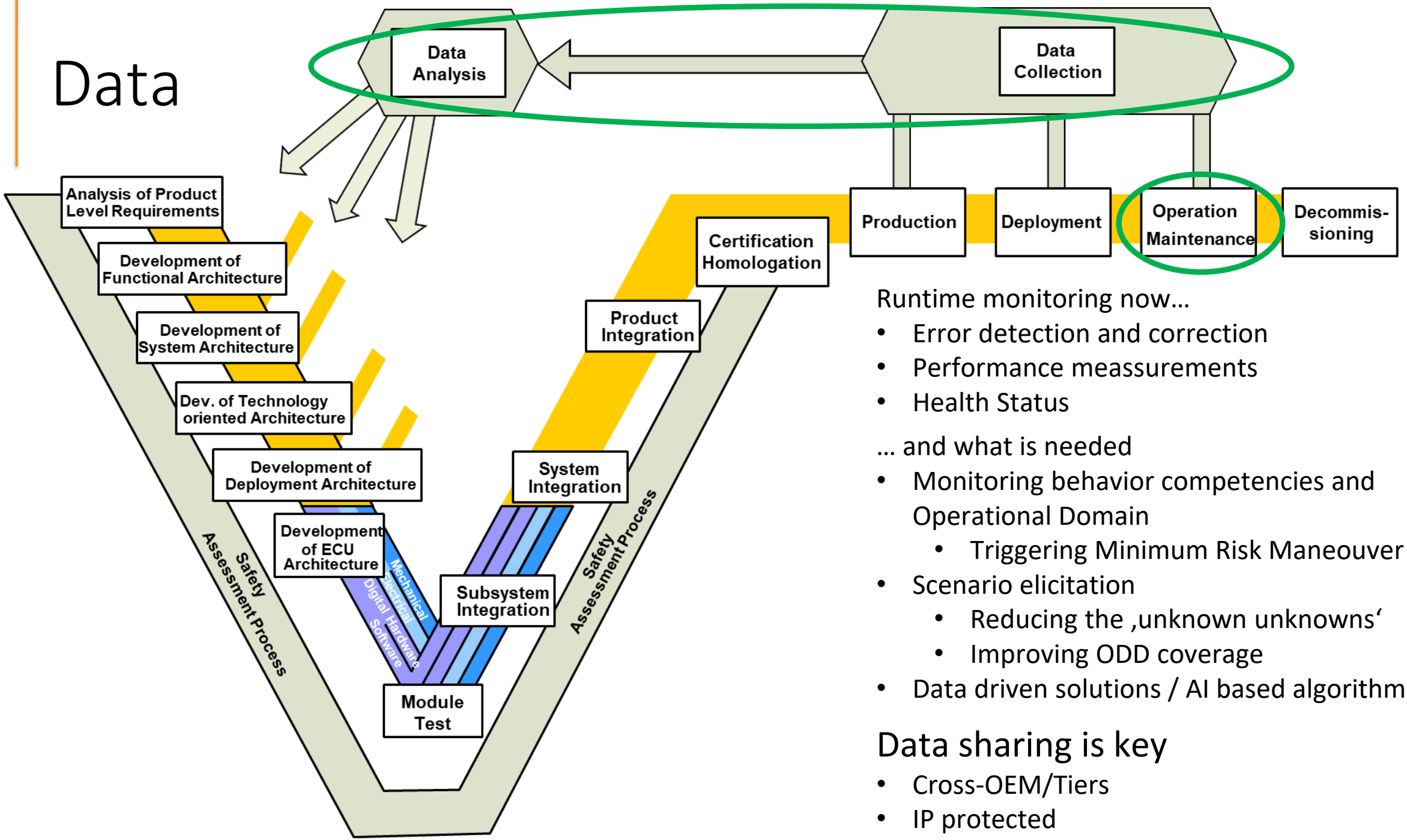


Deriving challenges



- New Challenges…
  - Incomplete requirements (open world), unknown scenarios, incomplete perception,…
- … are ‚handled' by
  - Scenario based tasting targeting behviour competences needed for ODD focusing on risk assessment
  - Combined with ‚in-field monitoring'
- Remaining Problems
  - (Relevant) Scenario Generation
  - How safe is safe enough?
    - ODD coverage
    - Behavior Competences Coverage
    - ‚Awareness of Unknown unknowns'/ disfunctional cases
  - Realism/ Accuracy of Models and Simulation
  - Uncertainties in perception

Data



Runtime monitoring now…

- Error detection and correction
- Performance meassurements
- Health Status

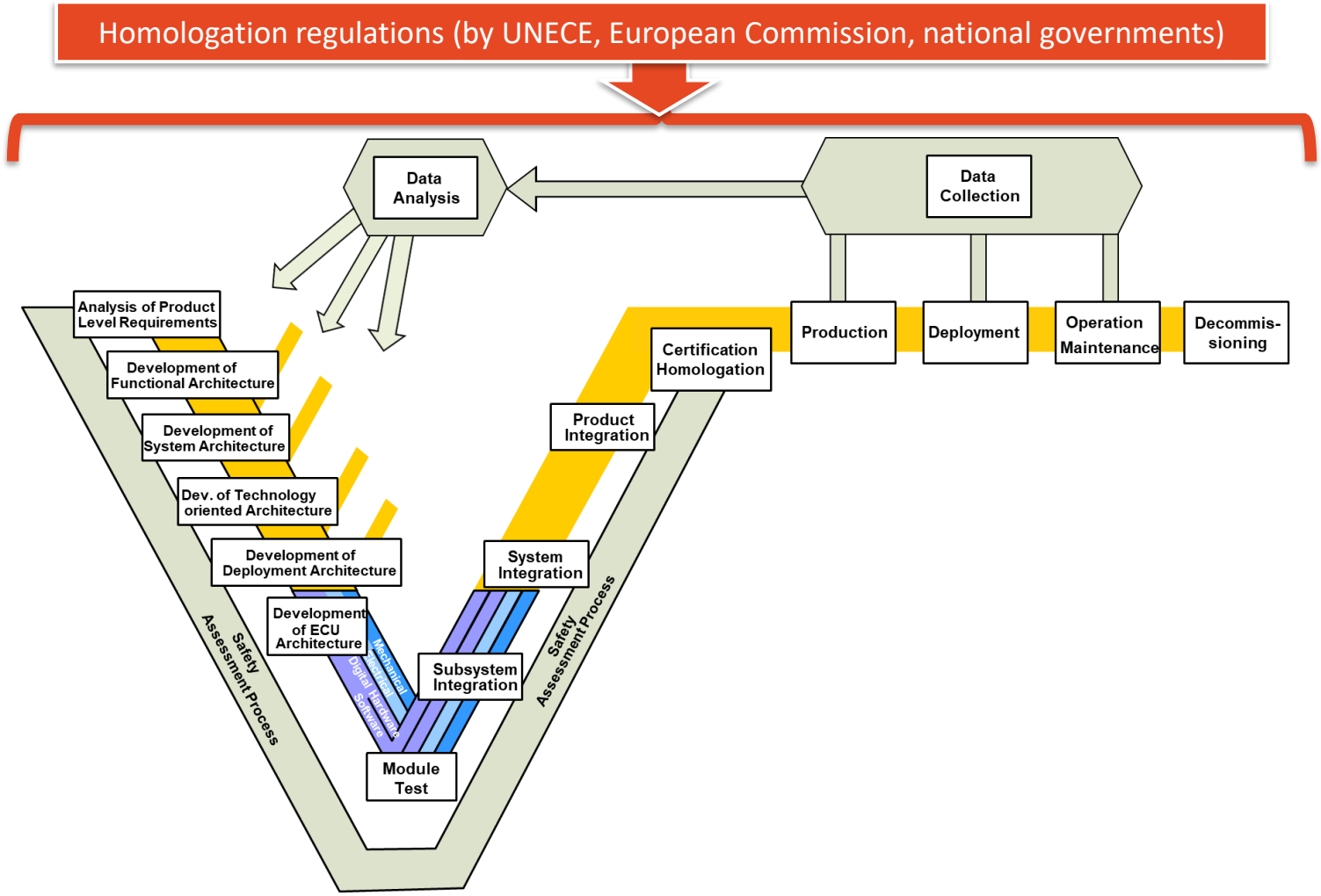
… and what is needed

- Monitoring behavior competencies and Operational Domain
  - Triggering Minimum Risk Maneouver
- Scenario elicitation
  - Reducing the ‚unknown unknowns‘
  - Improving ODD coverage
- Data driven solutions / AI based algorithms

Data sharing is key

- Cross-OEM/Tiers
- IP protected

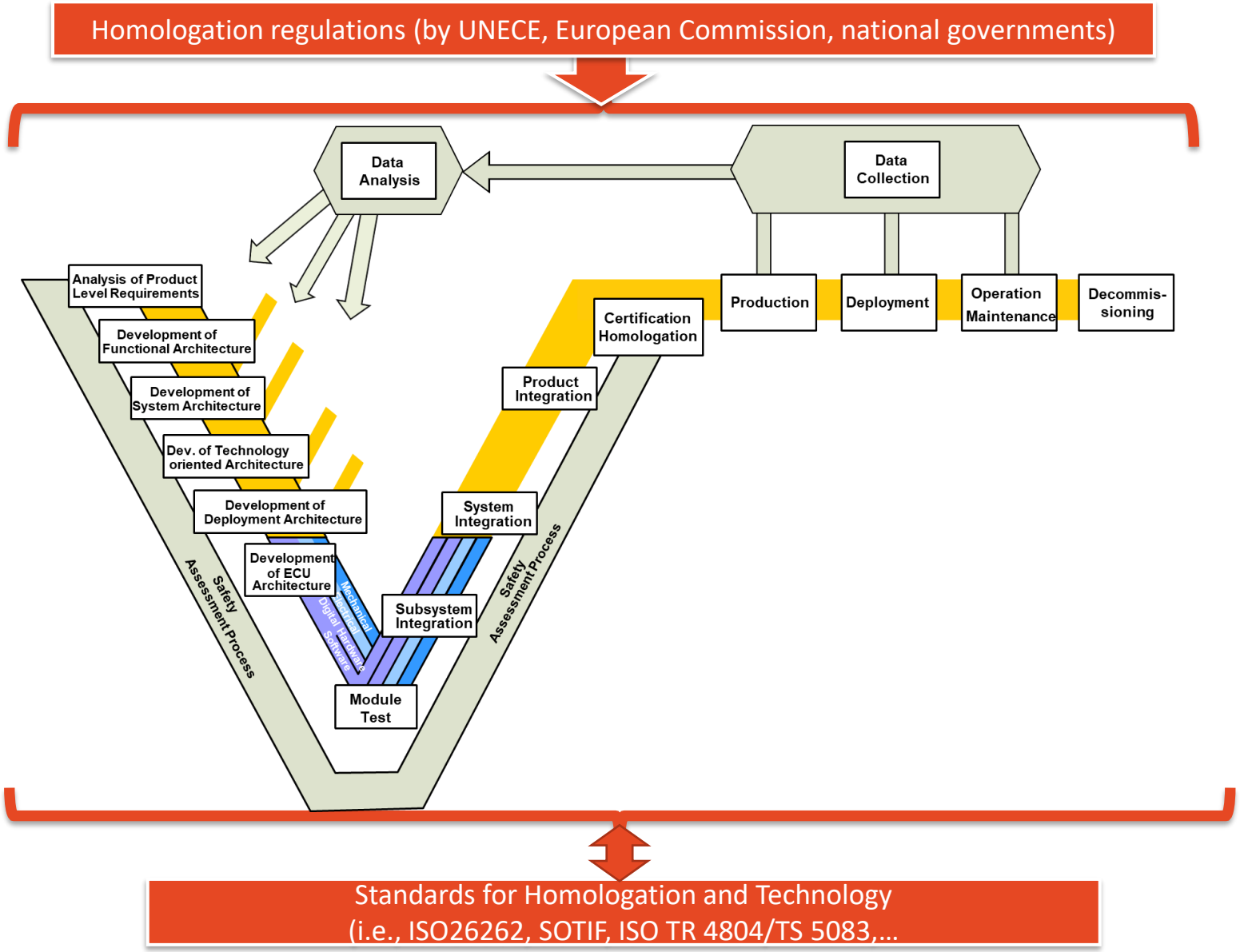
Compliance to Regulations



- New Regulations, e.g.
  - EU General Safety Regulation (EU) 2019/2144
  - New Assessment/Test Method for Automated Driving (NATM)
  - UN R157 (Automated Vehicles, ALKS), 2020 and 2022
  - EU ADS Regulations (fully driverless vehicles)
  - More to come…
- Checks
  - Compliance of technology bricks
  - Can the evidence required by regulations be provided?

- RHP has potential for uniform way of providing process information ot Audit of the 5-pillar approach

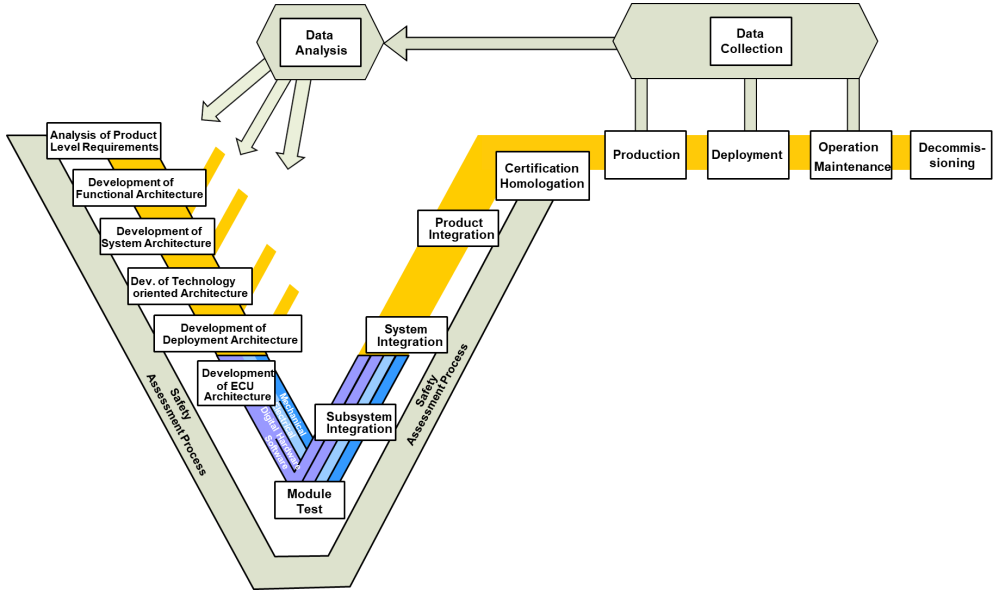
Support by Standards



- Homologation relevant Standards
  - ISO 26262 (Functional Safety) and ISO 21448 (SOTIF)
  - ISO TR 4804 resp. ISO AWI TS 5083 (Safety for automated driving systems — Design, verification and validation)
  - ISO 24089 (Automotive Software Updates)
  - ISO 21434 (Automotive Cybersecurity)
  - ISO 34503 (ODD)
  - ASAM OpenScenario, OpenODD,…
  - (UL 4600)
  - (RSS – responsibility sensitive safety)
- Missing
  - Behavior competences (analog ISO 34503)
  - (Critical) Scenario elicitation
  - …
- Fill gaps in existing standards, push new ones.

Take-away message

- Reference Homologation Process provides a uniform way to describe technology bricks – methods, processes, tools – needed for safety assurance/homologation of SAE L3+ ECAs.
  - Captures SoA
  - Allows re-use, prevents ‚re-invinting the wheel‘
  - Check lifecycle coverage: Identify missing pieces and links
  - Check compliance to regulations
  - Check support by standards
- Open Challenges
  - Scenario Generation, Scenario Database
  - Inclusion of Multi-Pillar Approach
  - ODD coverage, behavioral competencies coverage
  - Realism/accuracy of models and simulation
  - Uncertainty in perception
  - …



Thank You !

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