Requirement Driven Safety Verification

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Agenda

- Introduction and Scope
- Requirement driven development and verification
- Verification goals and coverage
- SysML modelling and example
- Conclusion

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Introduction and Scope

- Standard ISO26262 [1] was introduced in 2011 to address functional safety in modern automotive systems
- Addresses all development steps: ISO26262 covers whole lifetime of products used in automotive E/E systems
- Compliance to safety requirements: 130 work products for whole V-model
- RDDF: ISO26262 widely utilizes safety requirements at all abstraction level for all its work packages
- RDDF usage by Infineon: HW and SW development, verification and validation for Aurix™ MCUs
- Scope:
  - Aurix™ MCUs development according to ISO26262 Part 4 and Part 5
  - Requirements capturing and refinement
  - Modelling at different abstraction levels
  - Safety verification based on RDDF

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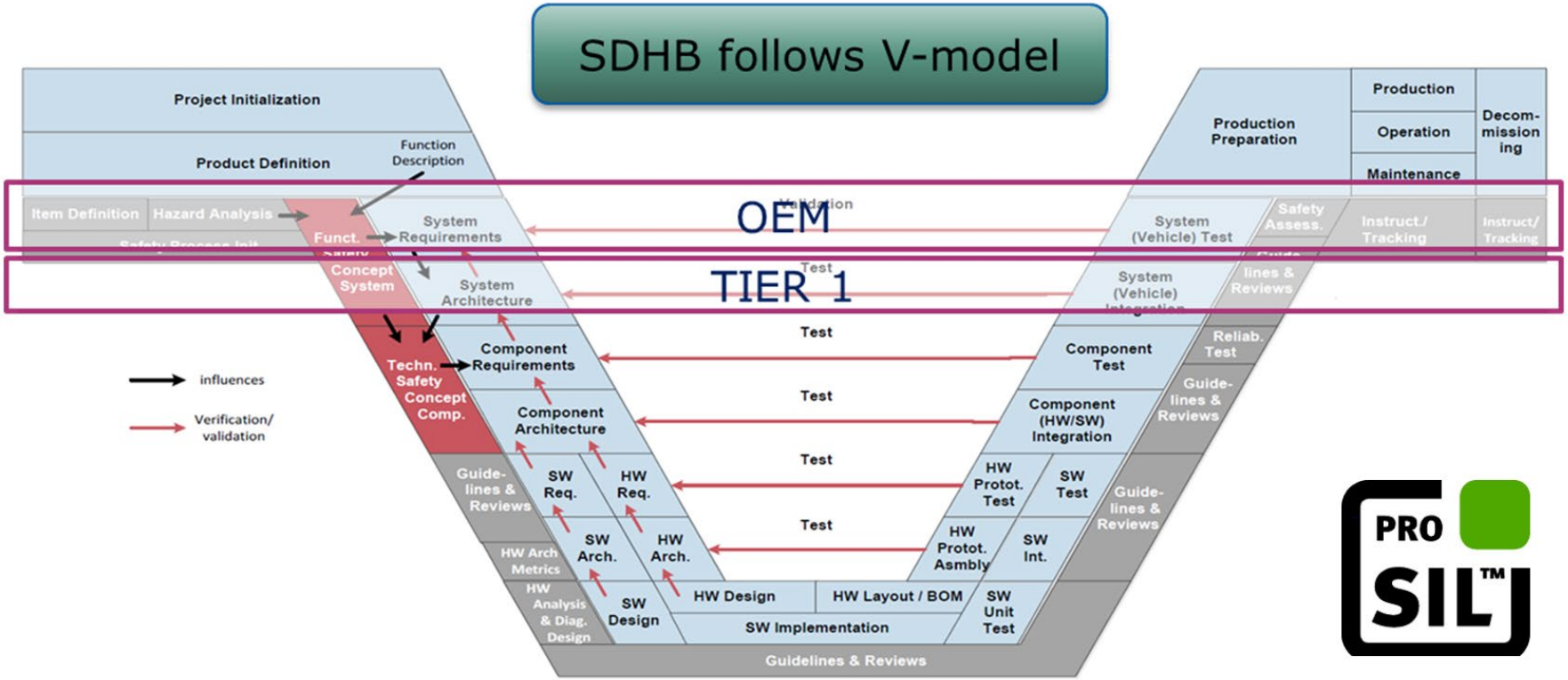
Introduction and Scope

- IFX SDHB: System Development Hand Book



Requirement driven flow

- ISO26262 Requirement Flow
  - Based on requirements: the standard considers work packages to be generated during product development at two levels: system and hardware
    - Technical Safety Requirements (TSRs) for System level and Hardware Safety Requirements (HSRs) for Hardware level,
    - TSRs and HSRs are required for safety verification and validation steps at the related levels,
    - Both types of requirements are also a crucial part necessary for the Functional Safety assessment of the product.
  - TSRs and HSRs are key for all further steps of development: TSRs for the System-level, HSRs for Hardware-level Development and Verification.
- Requirement Driven Development Flow (RDDF) and ISO26262
  - RDDF is not developed only to be conformant with standards like ISO26262 and IEC61508
  - Systematic and discipline approach to systems development at all levels:
    - Customer requirements collection and documentation
    - System definition and documentation
    - Planning of activities at all levels
    - Compliance with standards like ISO26262
    - Verification and validation at all levels including reviews
    - Evidence collection
    - Traceability at all levels

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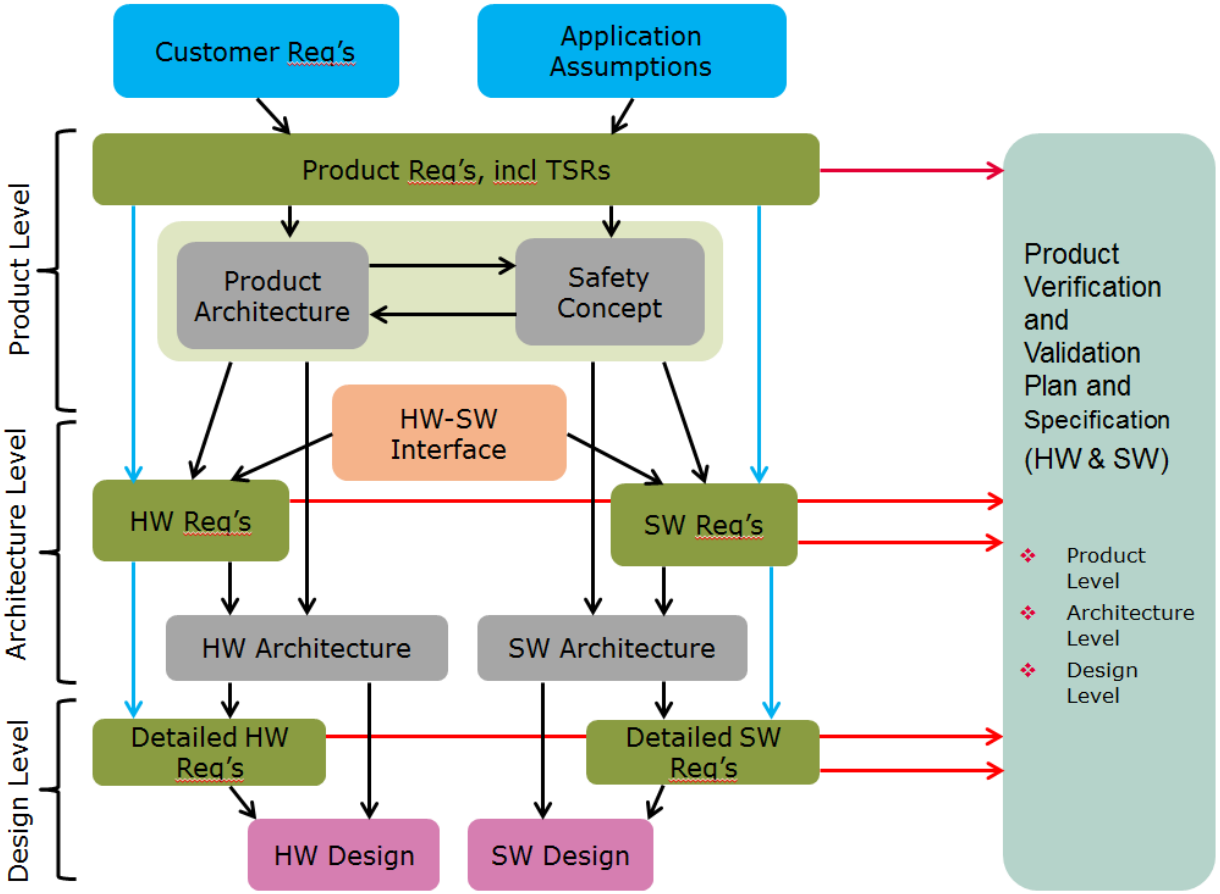
Requirement driven flow

RDDF workflow: 3 requirements databases are created.

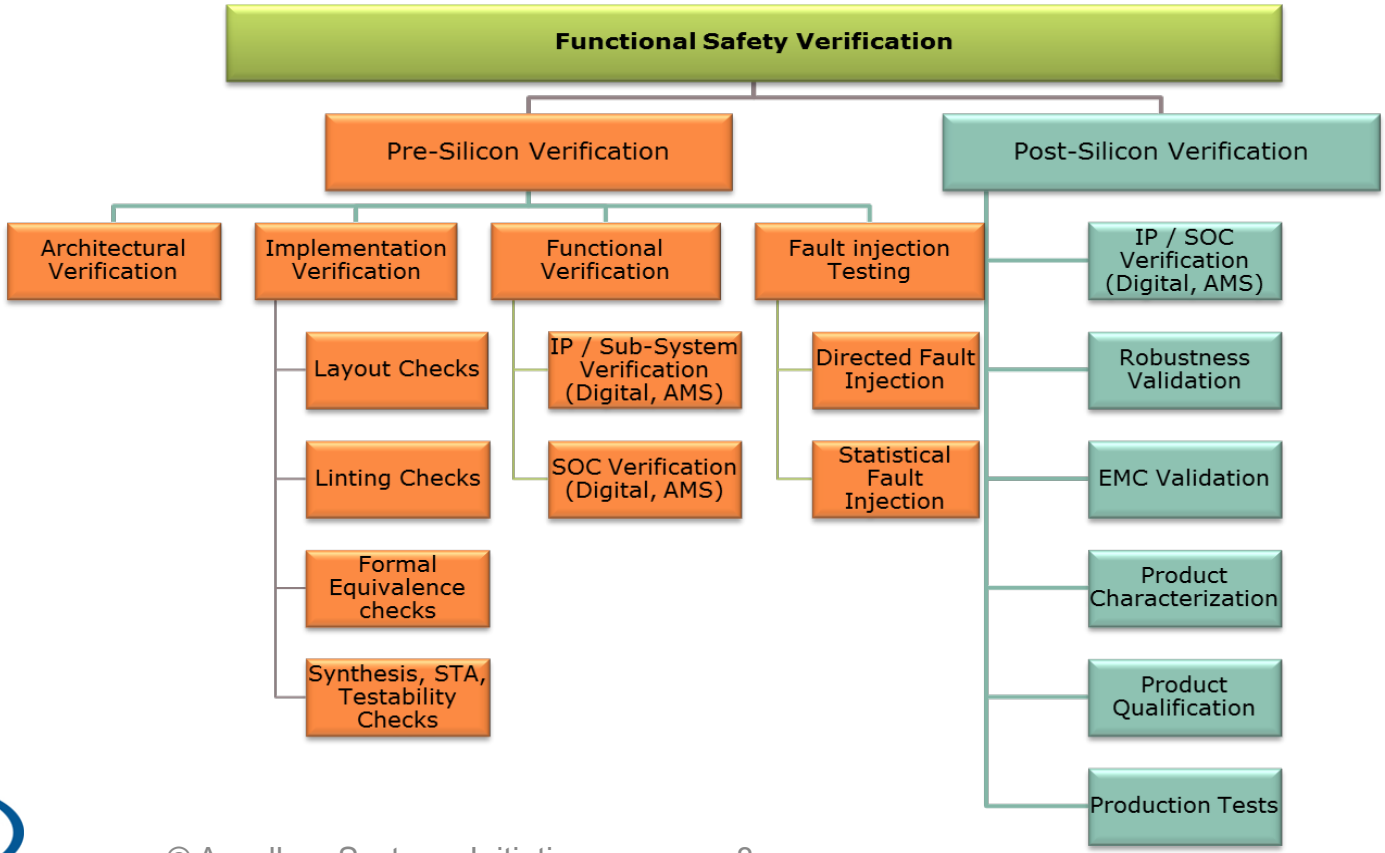
- Further used in verification and validation flows also at three levels: Product, Architecture and Design.



Verification goals and coverage

FuSa Verification and Validation main objective:

- Verify the HW Part/SEooC based on the Safety requirements (up to ASIL D) for its correctness and completeness
- Considering **ISO26262-5, Table 3, 10, 11, 12 and ISO26262-10 Annex A, Table A.8 7.4.4 – Verification of HW design** recommendations.



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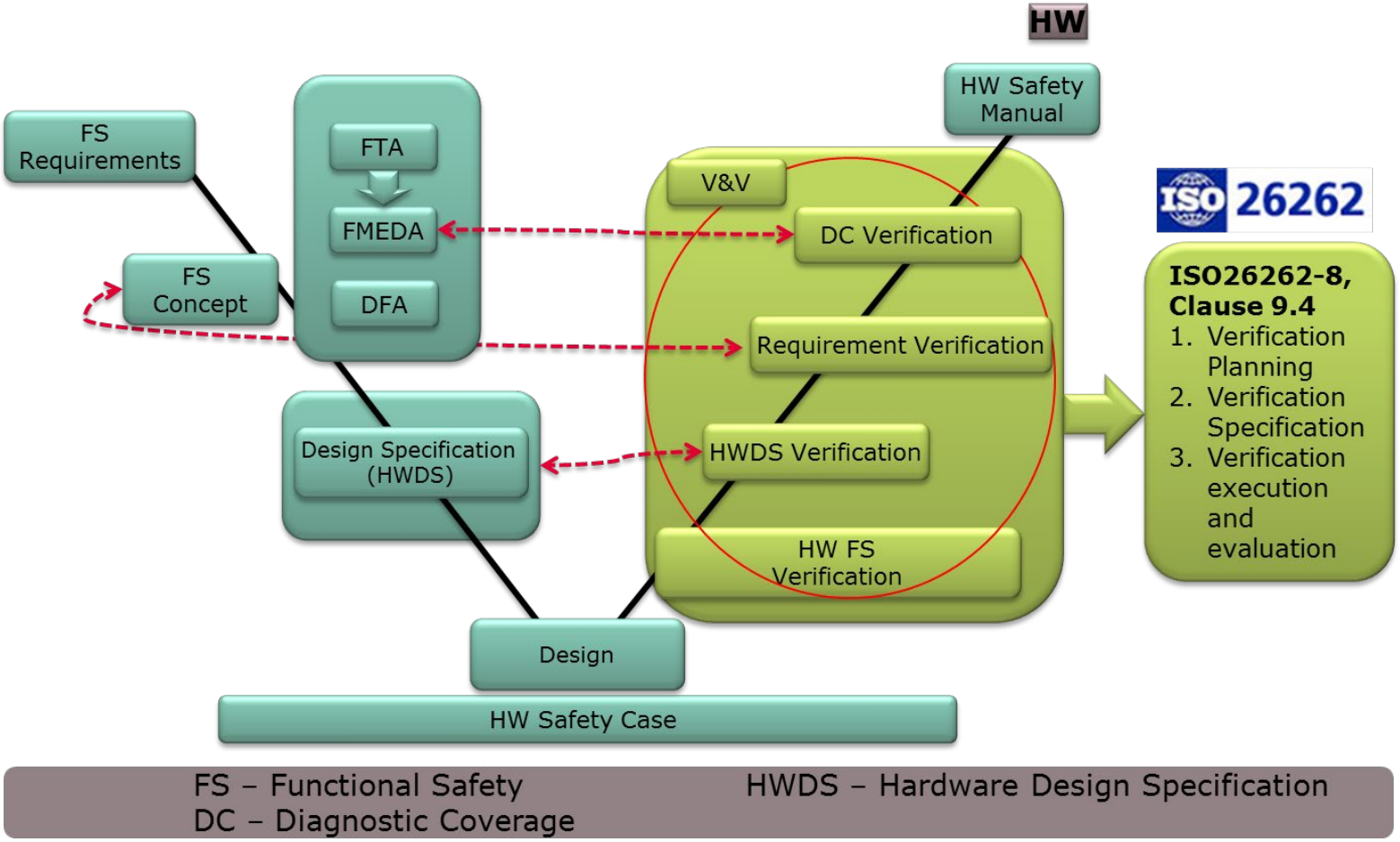
Verification goals and coverage



SysML modelling and example

- Model driven systems engineering is gaining momentum in the automotive industry.
- Initially focused on UML for SW components modelling the trend is now to use the SysML extensions.
- SysML enables to model different aspects of HW and SW and especially their interactions.
- The key advantage of using SysML: requirements, structural, behavioral, temporal, state models exist under a global system model and follow a logical decomposition that enables to capture the overall interactions and dependencies of the system.
- Advantages:
  - Functional safety verification can take advantage of the richness of the modeling to build scenarios that are representative of the safety claims.
  - SysML model itself provides the rules to verify consistency and completeness of the information.

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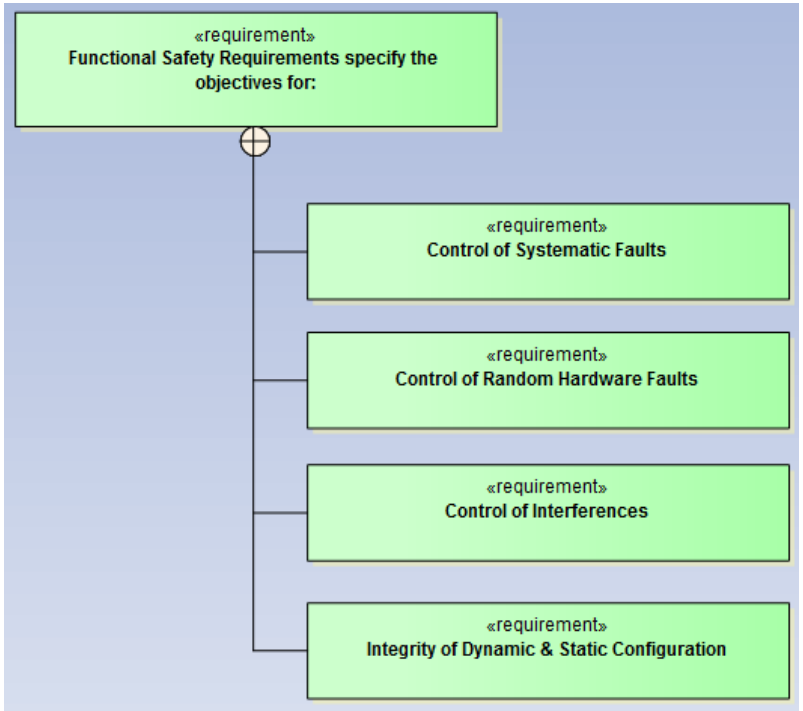
SysML modelling and example

- SysML model for safety system has different viewpoints:
  - Failure behavior: essential aspect that drives the technical decisions.
  - The failure analysis is hierarchical: from behavioral aspects down to architectural and design descriptions.

- SysML modelling allows to:
  - Build a safety argumentation and
  - Enable argumentation verification,
  - Understand the chain of analysis and how a given artifact is supporting a requirement specification (a rationale).



Example of requirements structuring model that can be enforced at the different levels of the architecture.

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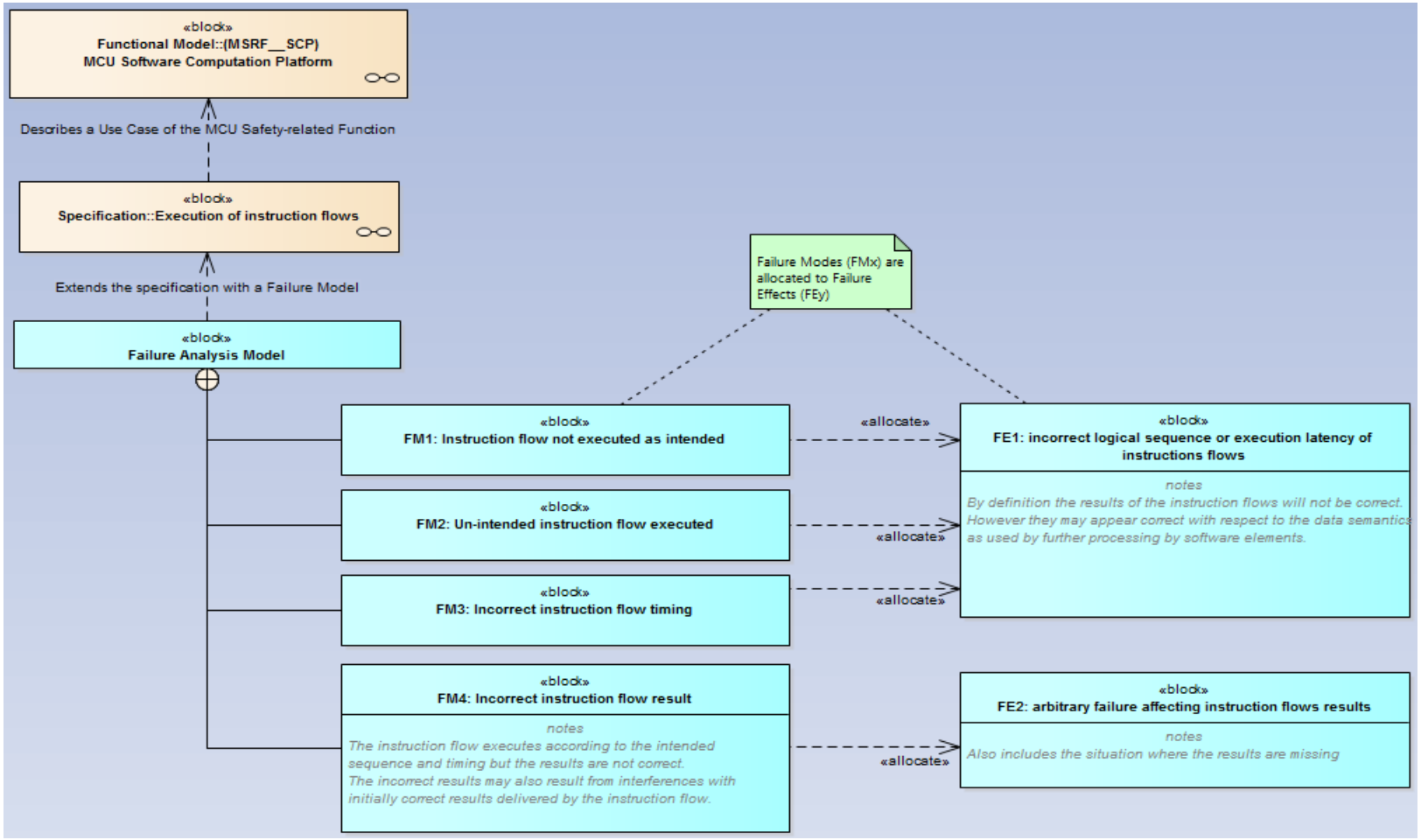
SysML modelling and example

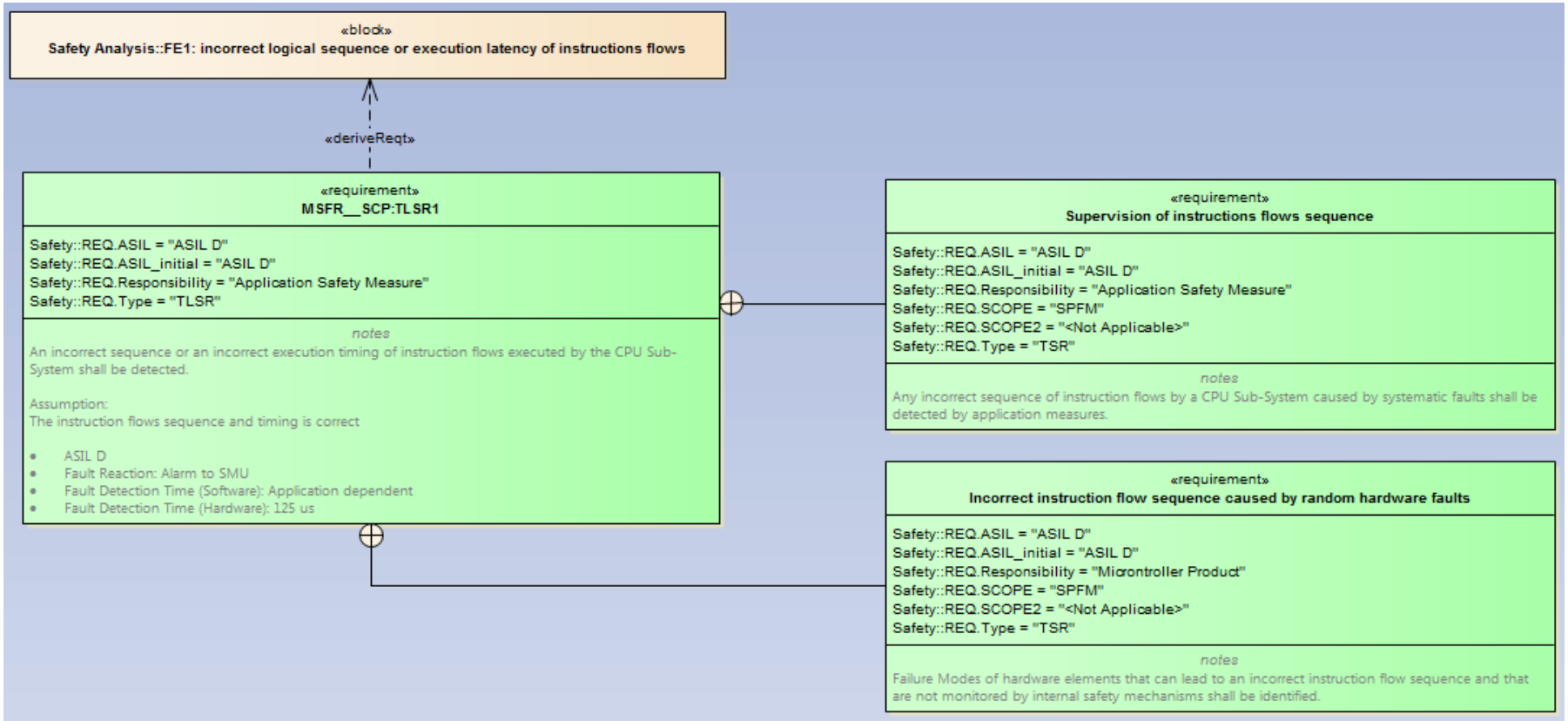
Further modelling stages allow extraction of requirements from the results of the failure analysis.



SysML modelling and example

Using SysML from verification viewpoint modeling allows to:

- Verify that the requirement is properly implemented and also
- Create verification scenarios that check requirements are sufficient and complete for all Failure Modes



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Conclusion

- Efficient development and verification approaches are necessary
  - to address increasing complexity in automotive HW products,
  - together with requirements from ISO26262 standard.
- Advantages of requirement driven development flow
  - uses functional models to represent use cases and resulting requirements.
    - These requirements are then refined at lower levels and
    - Proven for correct implementation on all abstraction levels by verification.
  - Verification can start before hardware is implemented and available
    - Requirements on high abstraction levels are available very early in development process.
    - Allows to avoid expensive and time consuming rework.
  - RDDF flow enables almost parallel development at all levels and
  - It delivers crucial evidence required by the ISO26262 standard
    - Necessary for product functional safety assessment and certification.
  - This flow perfectly fits:
    - Product definition and modelling at high level with SysML
    - Requirements capturing and finally
    - Product verification and validation to proof its compliancy to ISO26262 already at early development stages.

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Many thanks for your attention!

Questions