Transition to ISO 26262-6 compliant development through gap analysis

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Abstract

ISO 26262 2011 First Edition has been superseded by 2018 Second Edition and both have become a base requirement for winning new business. ISO 26262 Part 2, Management of functional safety, emphasizes the importance of having a process in place to execute a Functional Safety project and to have trained staff to design product per the process. To execute a Functional Safety project it is important to quickly establish if your existing processes can be mapped to ISO 26262 or if you have to create new work flow and procedures. It is important to create the Safety Plan quickly and to conduct a conformation review so that the entire team recognizes deliverables and responsibilities. If you have never executed a ISO 26262 project it is also a good idea to contract expert advice by requesting a Gap Analysis. This formal feedback is important to drive and direct necessary resources and focus on deliverables necessary to meet the expectations of the Assessors.

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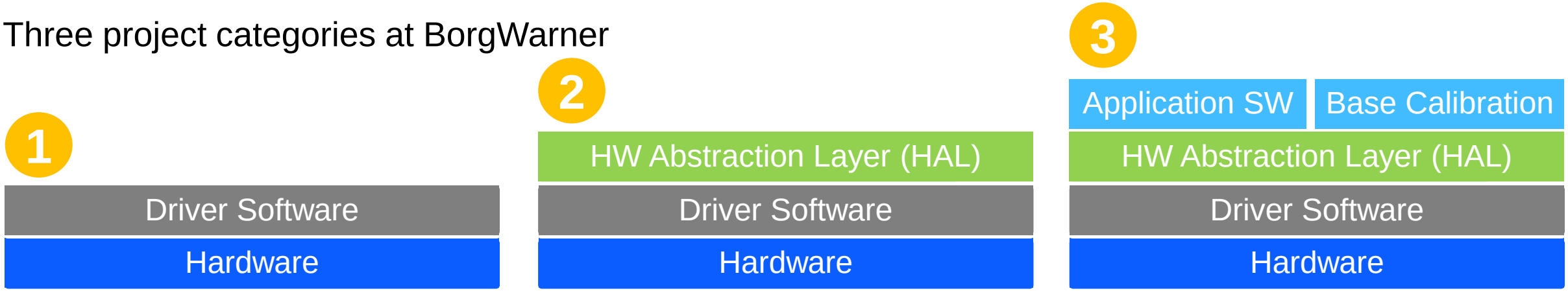
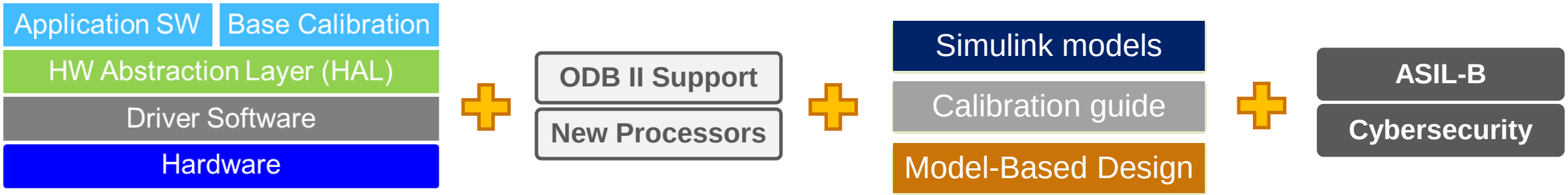
Project Background

Three project categories at BorgWarner



Project sharing today is based on category 3 + additional requirements



Project Starting Point

EXPERIENCE

- Company process training
- Practical product experience
- Implementing Functional Safety Req from customer
- Implementing Technical Safety Req from customer
- External training on specific tools and in areas of interest

- Upgrading development process to ISO 26262:2018
- Staffing Function Safety Engineering team
- Staffing System & Software Quality Assurance (QA) team

KICKOFF

- Development Interface Agreement (DIA)
- Safety Plan was delivered

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The Project Mid Point

- Hardware Design
  - Provided to customer first for in vehicle testing of new software and features

HARA and Functional Safety Concept provided by the customer, then co-develop Technical Safety Requirements

Leverage COTS tool – ANSYS medini™ analyze

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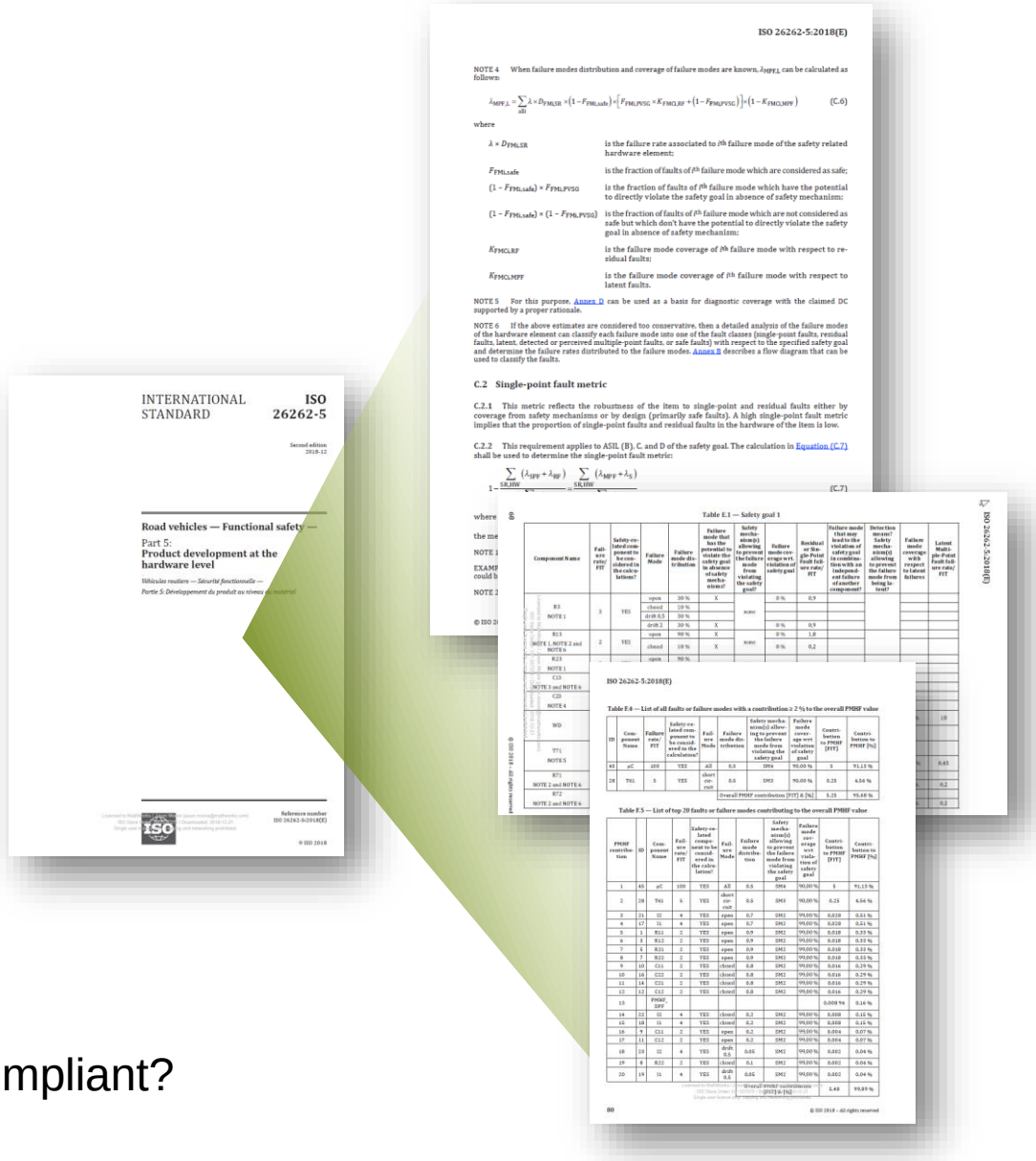
Hardware Analysis

- ISO 26262 provides detailed instruction for hardware with explicitly defined metrics and calculation methods

Safety Plan → Safety Concept → Technical Safety Requirements → Hardware Safety Analysis



- This is not the case for Software requirements or ISO 26262-6
  - Due to the potential of systematic failure in software
  - Is our Model-Based Design development process ISO compliant?

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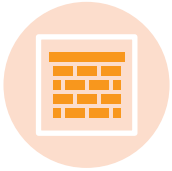
The ISO 26262 Gap Analysis

Project Objectives

Independent evaluation prior to final Audit and Assessment

Evaluate the implemented process and ensure work products are of sufficient quality

Technical Objectives



Implementation methods for Freedom from Interference using MBD

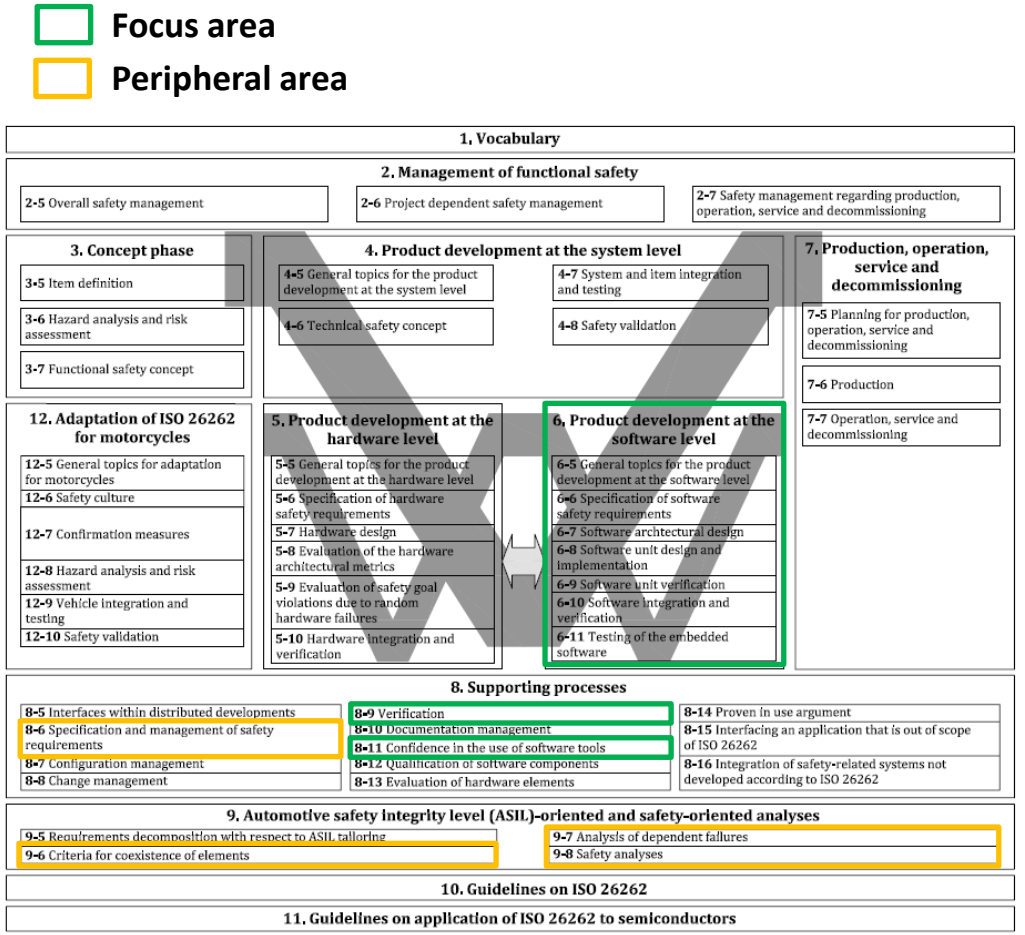
ISO consideration between “purchased code” and “reuse code”

Efficiency improvements in using MathWorks toolchain

Review of Tool Qualification artifacts

The ISO 26262 Gap Analysis

- Weeklong daily interviews were held with the product development team to review their work products.
  - AM – Interview and work product reviews + feedback from previous day
  - PM – Analysis and review of results
- Final deliverables:
  - Gap Analysis Report
  - Examples (model/scripts)
- With the knowledge gained from the Gap Analysis Report, resources could now be directed to start the process of filling the gaps and ensuring that we would have the necessary work products for an Audit and Assessment.



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Architecture

Code Verification

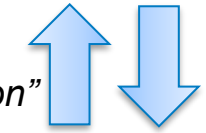
Tool Qualification

Filling the Architecture Gap

- Like many automotive projects, this project starts from a base of legacy production program.
  - Most of the design were from bottom up
  - Need to reconcile and ensure safety analysis is done per ISO requirement

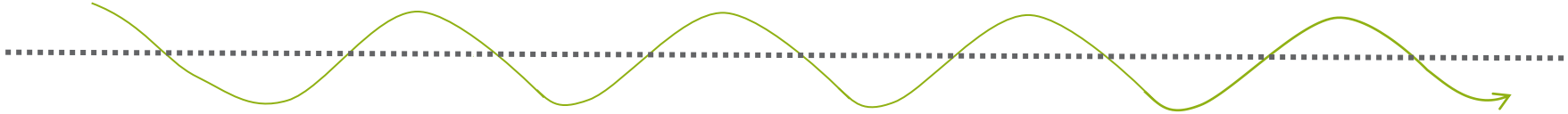
System Engineer
(ISO 26262-4)

bi-direction tracing Polarion "add-on"



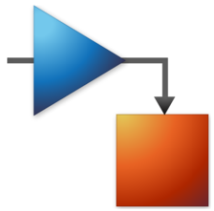
Focuses on software requirement and performing FMEA and DFA work. The results are documented, reviewed, and traced inside Polarion.

System engineering was new and was iterated with updates to software functions/features



Very practical way for executing ISO project with legacy base software

Software Engineer
(ISO 26262-6)



Focuses on software implementation and model verification workflow based on customer feature/functions and direction from System Engineering

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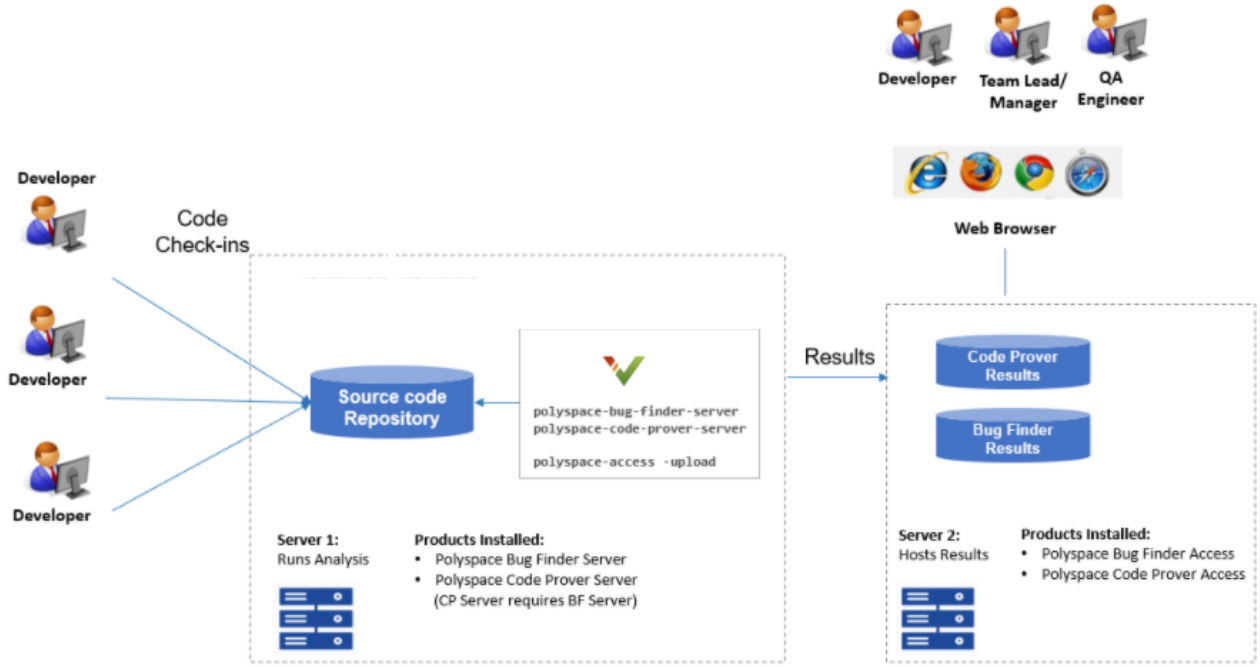
Filling the Unit Test Gap (ASPICE 3.0, SWE.3 – SWE.4)

- Polyspace was used for static code analysis
  - Run-time errors
  - Coding standards (e.g., MISRA)
  - Coding metrics

- Issue: the turnaround time for Polyspace was too long for development feedback – 2 weeks for a run



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Implement recommendation configurations with MathWorks guidance

Improve Server compute power
Implement parallel processing
create batch processing

Multi-core CPU

- Result
  - **Went from 2 weeks to overnight runs** provide “ near real time” feedback.
  - Polyspace Access was also used for generating Web accessible report back to development team .

Filling the Gaps – Tool Qualification

- For MathWorks tools, tool qualification was done based on internal know-how from BorgWarner's technical expertise.
- For MathWorks toolchain, the results were reviewed against IEC Certification Kit as offered by supplier with similar contents.

ISO26262-8:2018 Clause 11
Confidence in the use of Software Tool

ISO Work products

Software tool criteria evaluation report

Software tool qualification report

MathWorks IEC Certification Kit

Tool Qualification Package
- Planned tool usage
- Tool classification analysis

Tool Qualification Methodology &
Evidence for pre-qualification artifacts:
- Tool requirement, test case, and traceability
- Independent review of tool development process

- BorgWarner will be leveraging MathWorks Certification Kit for ISO tool qualification

Lessons learned in roles, tools, and process migration

- A Functional Safety project requires a lot of extra work that must be completed in ISO 26262-compliant fashion and on schedule to satisfy the end customer and an independent assessor.
- Sharing what we learned with other teams in the department working on Functional Safety projects created more awareness of the required processes and deliverables.
- Training classes in Functional Safety are essential for the product development teams success.
- Bring awareness to management of the role of software engineering in the architecture phase of the project and the additional work products required by a Functional Safety project.
- Sharing the advantages of using tools to automate and reduce the workload of manually creating the additional work products, for example the Polyspace automation project.
- A Gap Analysis can be a great way to assess the current situation and develop an actionable plan for moving forward. This should be considered early on during project development cycle.
- Tool qualification should be planned and performed as part of the project planning process.

ISO26262 Gap Analysis

Thank you!