Engineering for human life

Model-based design and quality management

an automated process for safety-reliable production code

IWES 2022

Politecnico di Bari, 22-23 September

Agenda.

01 Software-defined vehicle

02 Safety and quality

03 ISO-26262

04 Solution

05 Results

1. Software-defined vehicle

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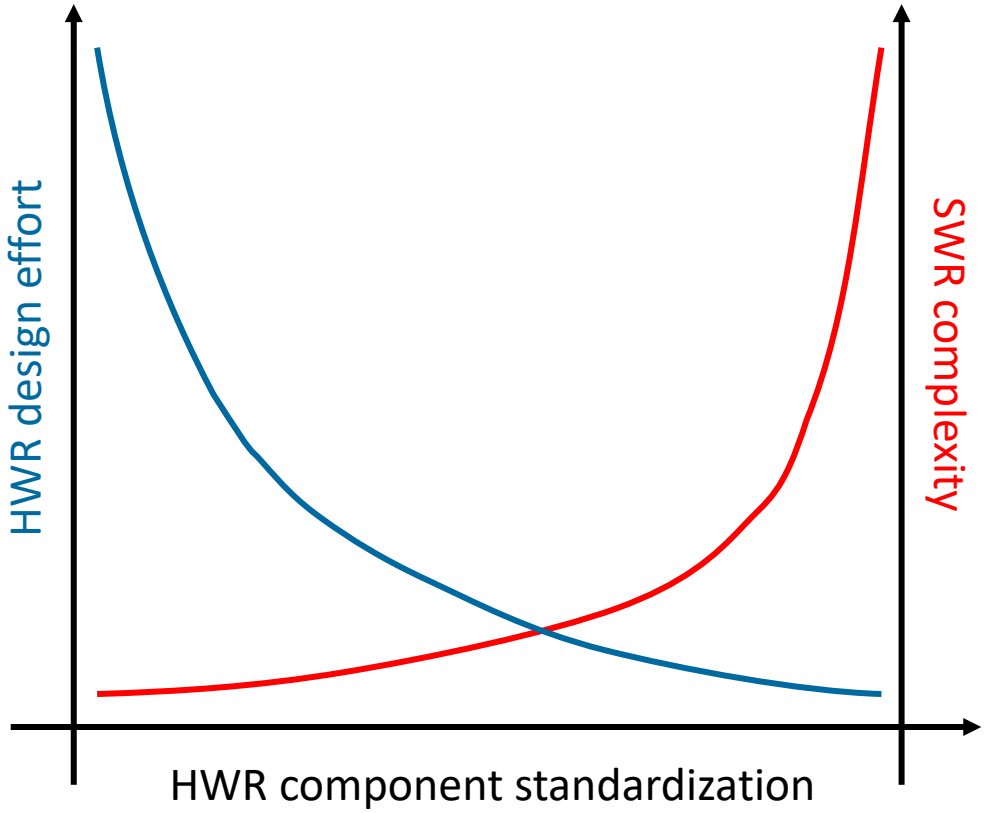
Introduction

The standardization of hardware components is lowering the effort in designing them, while increasing the demand for a *more and more efficient software*. In this scenario, the concept of **software-defined vehicle** comes into play.

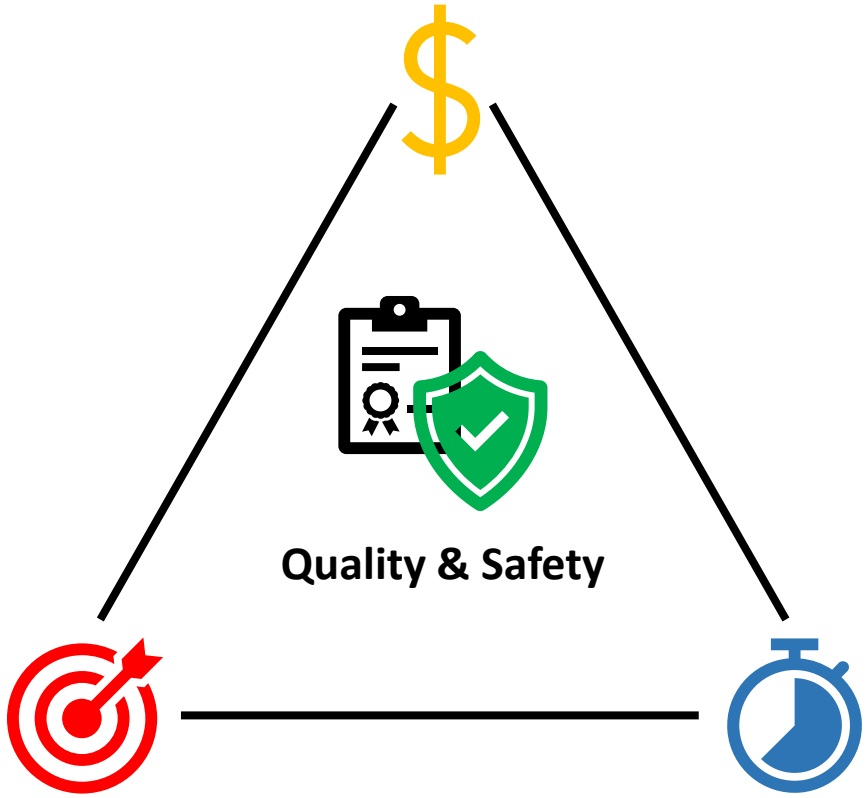
Nowadays, the electronic architecture of a vehicle includes up to hundreds of Electronic Control Units, with more than hundreds million lines of code: performances, configuration, connectivity and automation of vehicles are constantly upgraded by improving both the software and the development process; the car, which now can be considered a **connected and smart mobile device**, can be updated remotely (**OTA**), without entering a workshop.

Source1, source2



1. Software-defined vehicle.

New accountabilities for the software



The most obvious consequence of this new way of conceiving cars is that the **safety and security** aspects, previously attributed to the mechanical integrity and the performance of the parts constituting a vehicle, are now mostly related to the **software** and, not least, to the **quality management** during the **development process**.

As a result, in order to comply with quality management and new safety standards, the design goals are challenging, thus time and costs are increasing considerably.

2. Safety and quality

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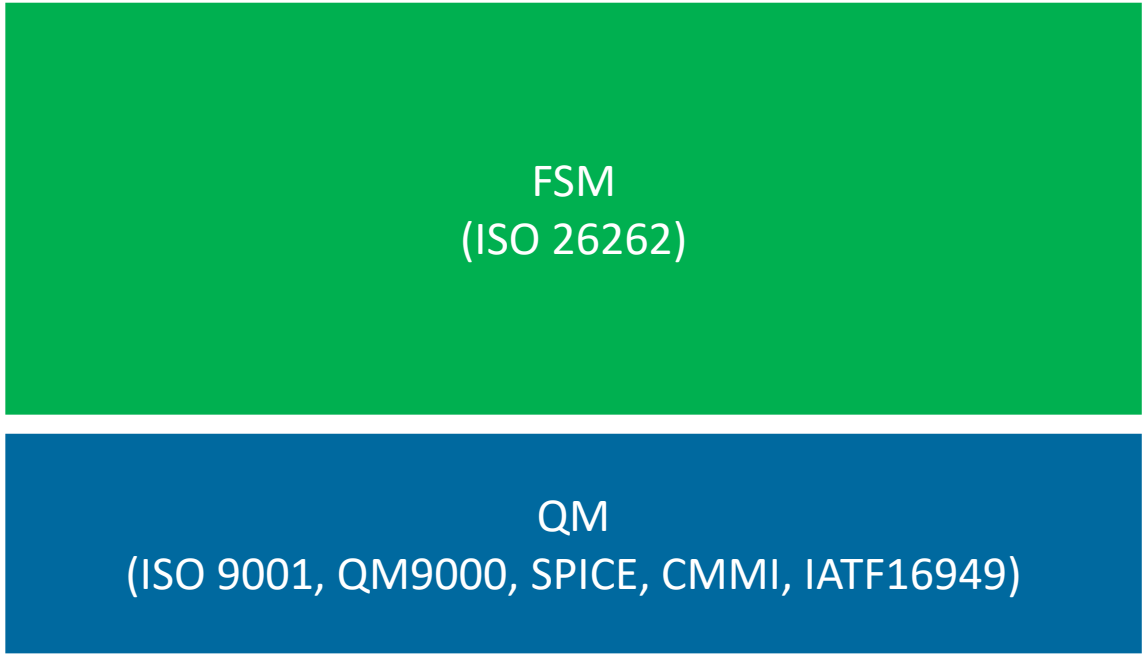
Good quality management for easily applying safety constraints

It is important for companies to be **certified** according to a **quality management** (**QM**) **standard** (ISO 9001, QM9000, SPICE). This would provide a strong foundation for building **functional safety management** (**FSM**), which is the logical improvement of QM requirements, taking safety aspects into account.

Moreover, a good QM defines a standardized and optimized process for producing documentation: this is the best starting point for developing **automatic solutions** for the QM and the FSM. This will help achieving the requirements for the certification according to a **safety standard** (**ISO 26262**).



3. ISO-26262

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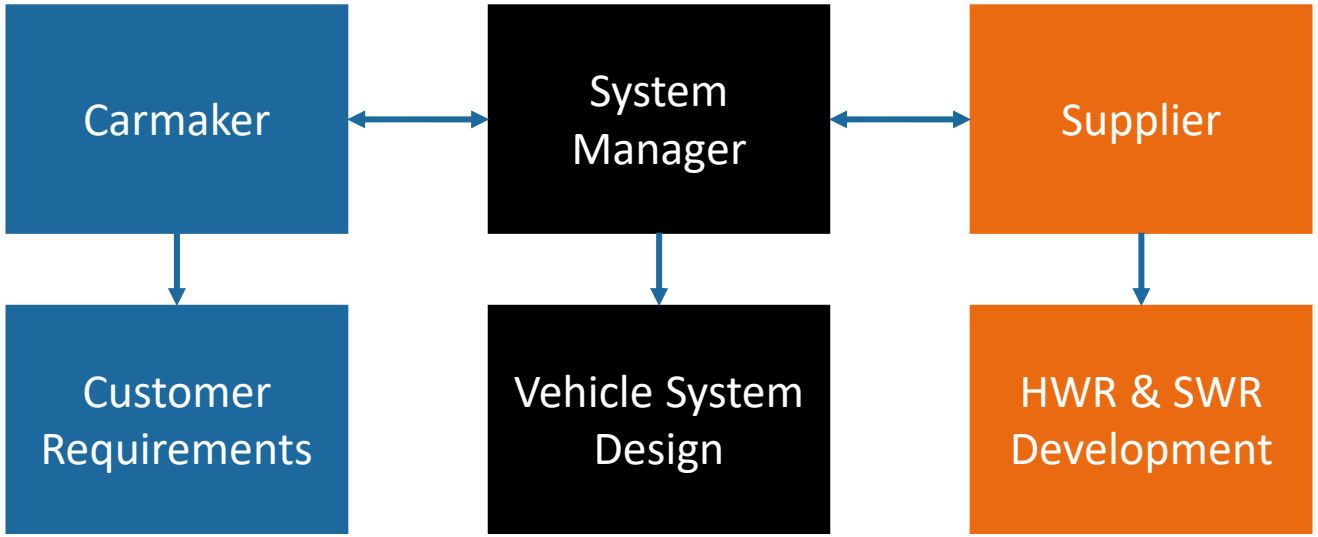
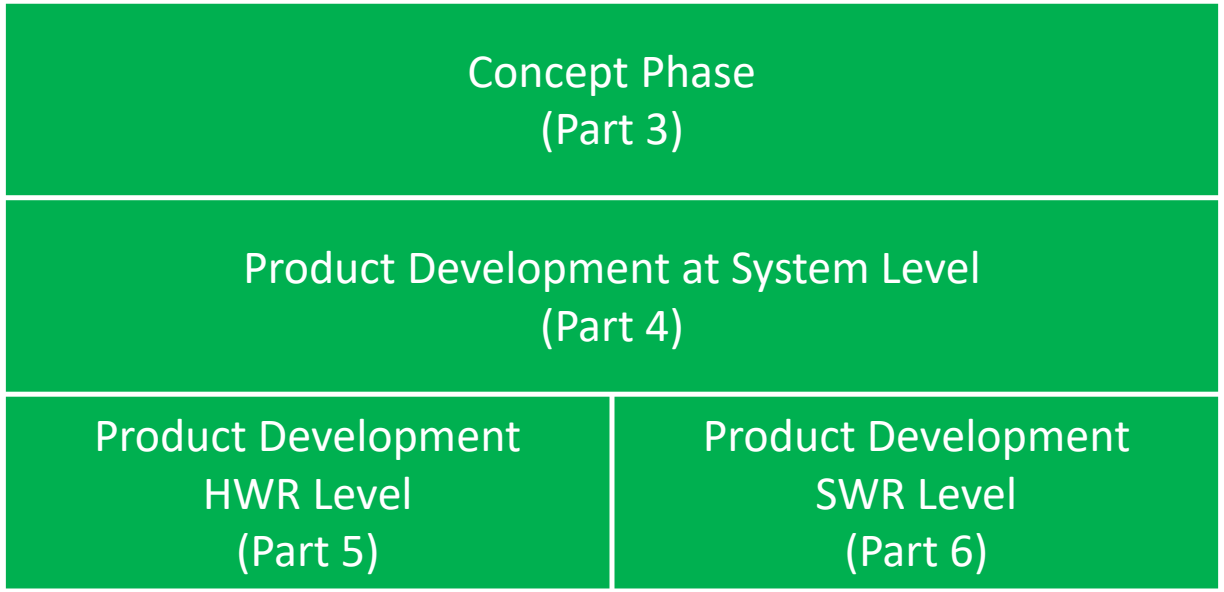
Actors



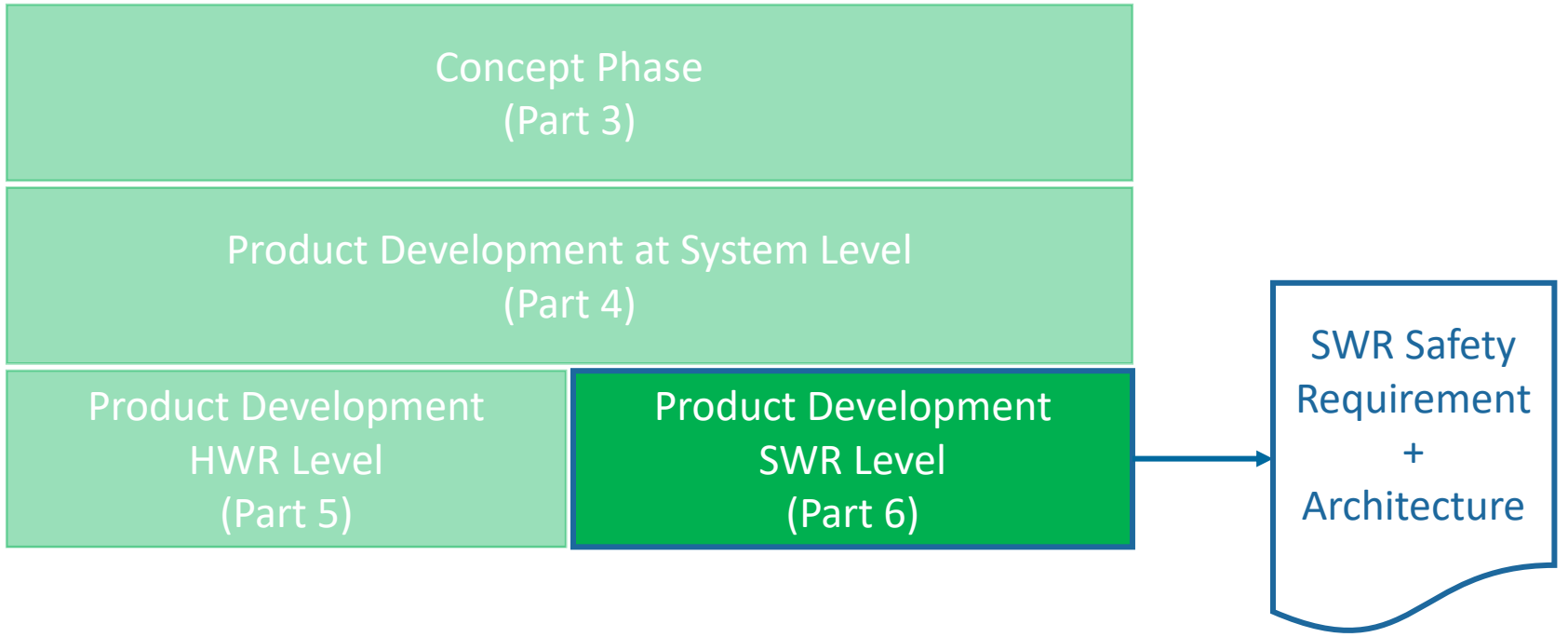
3. ISO-26262.

Process-long support



3. ISO-26262.

Part 6 WP's




4. Solution

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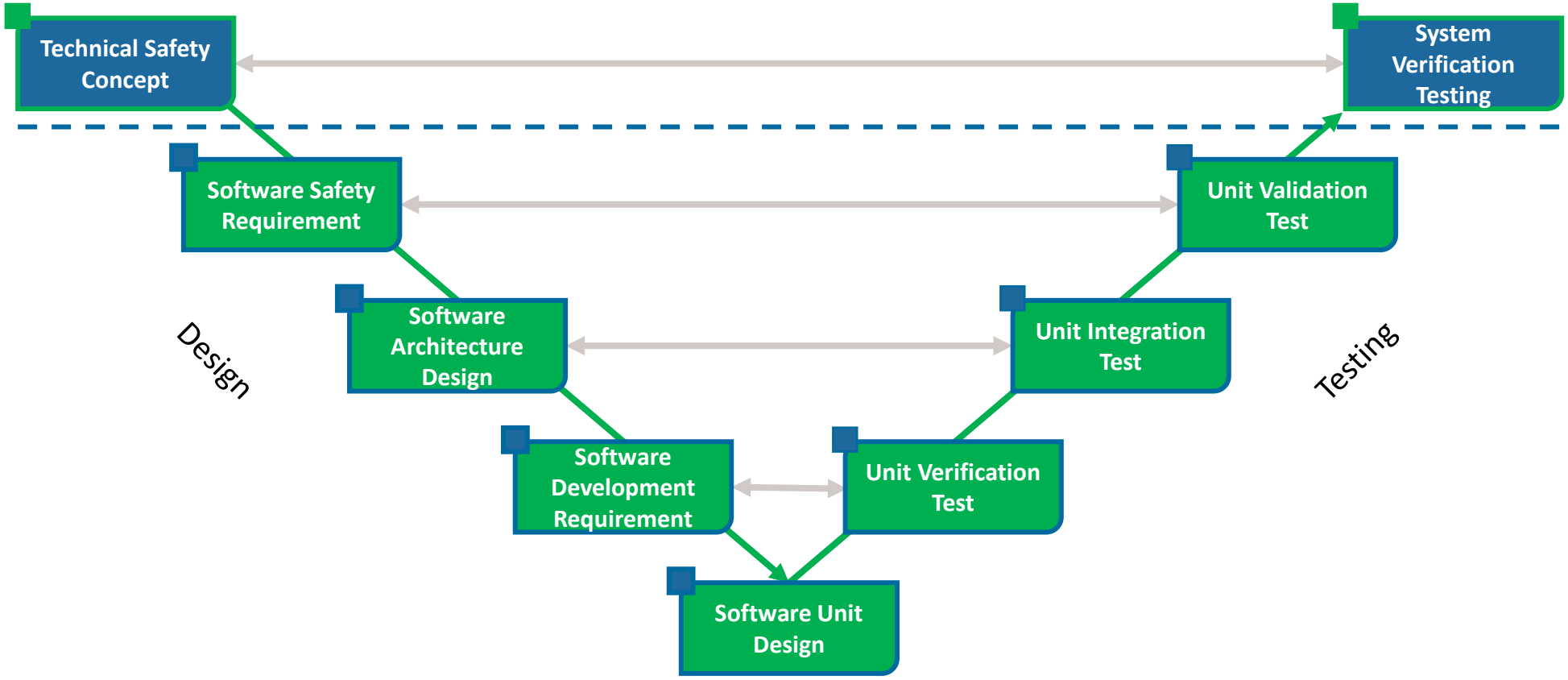
Software development and testing



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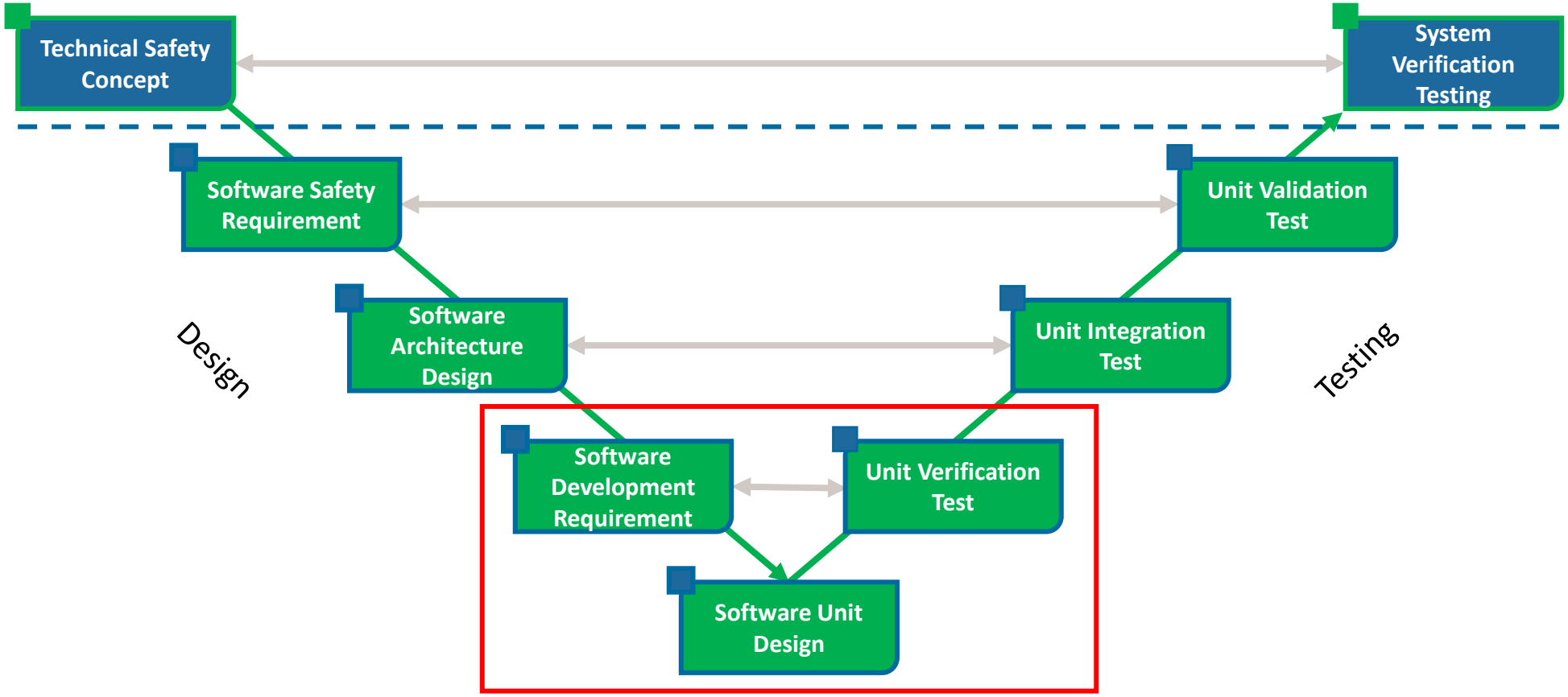
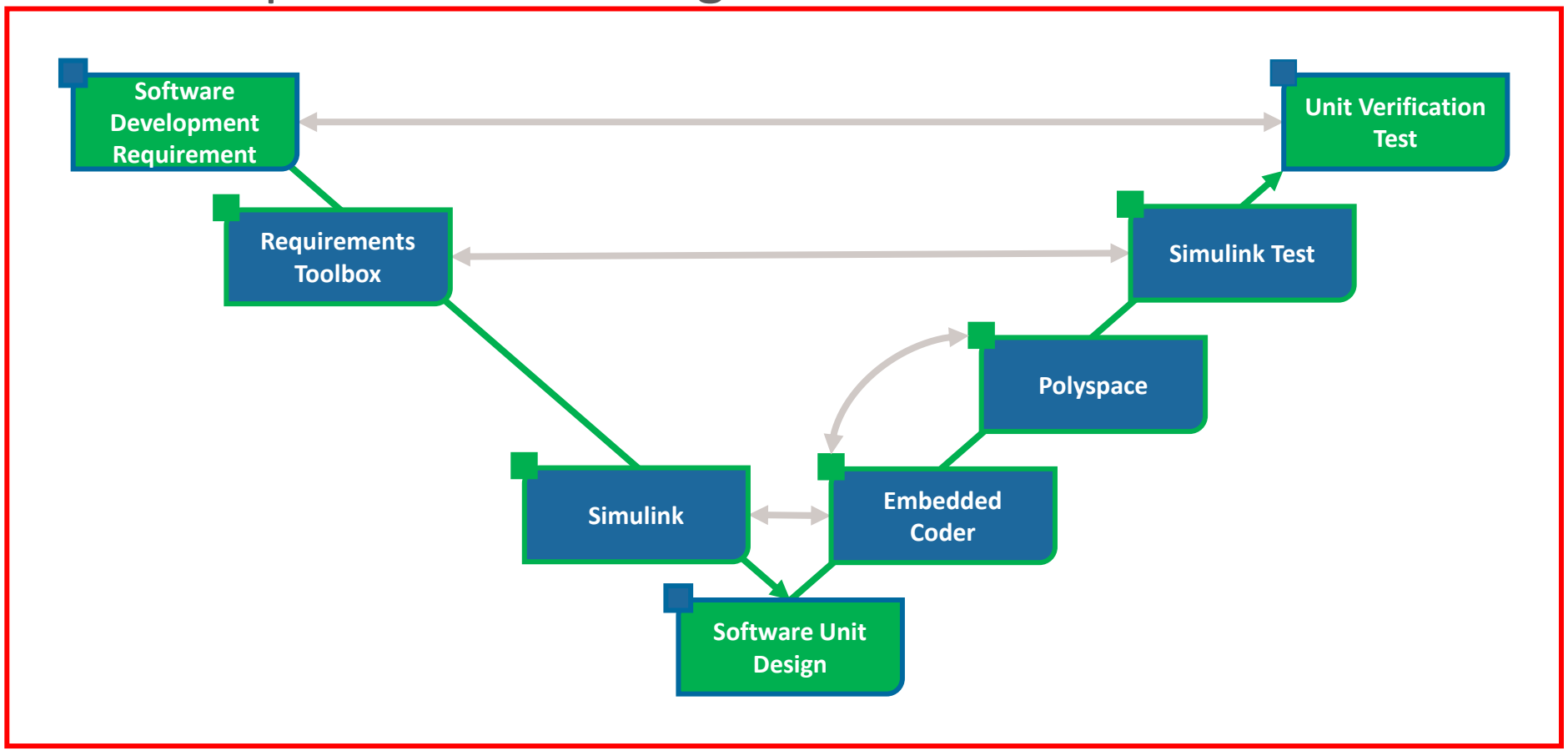
Software development and testing

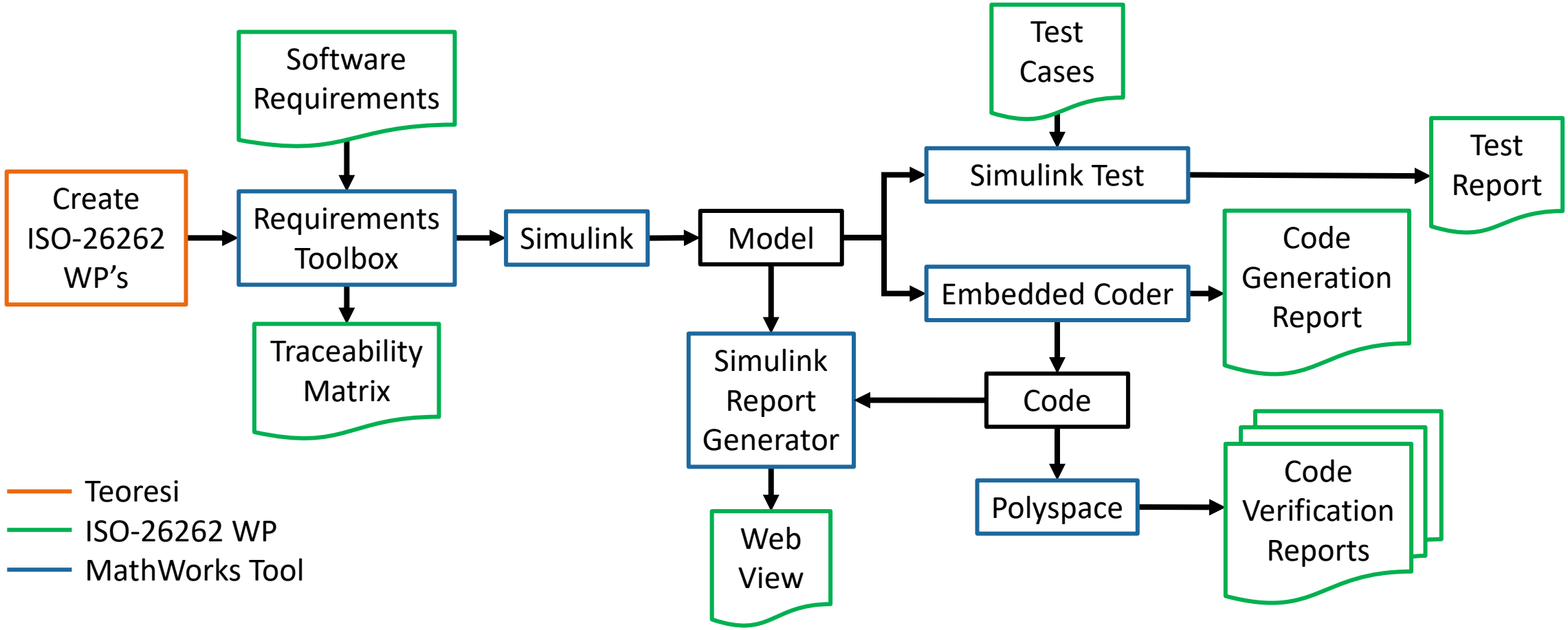


4. Solution.

Software development and testing



4. Solution.




5. Results

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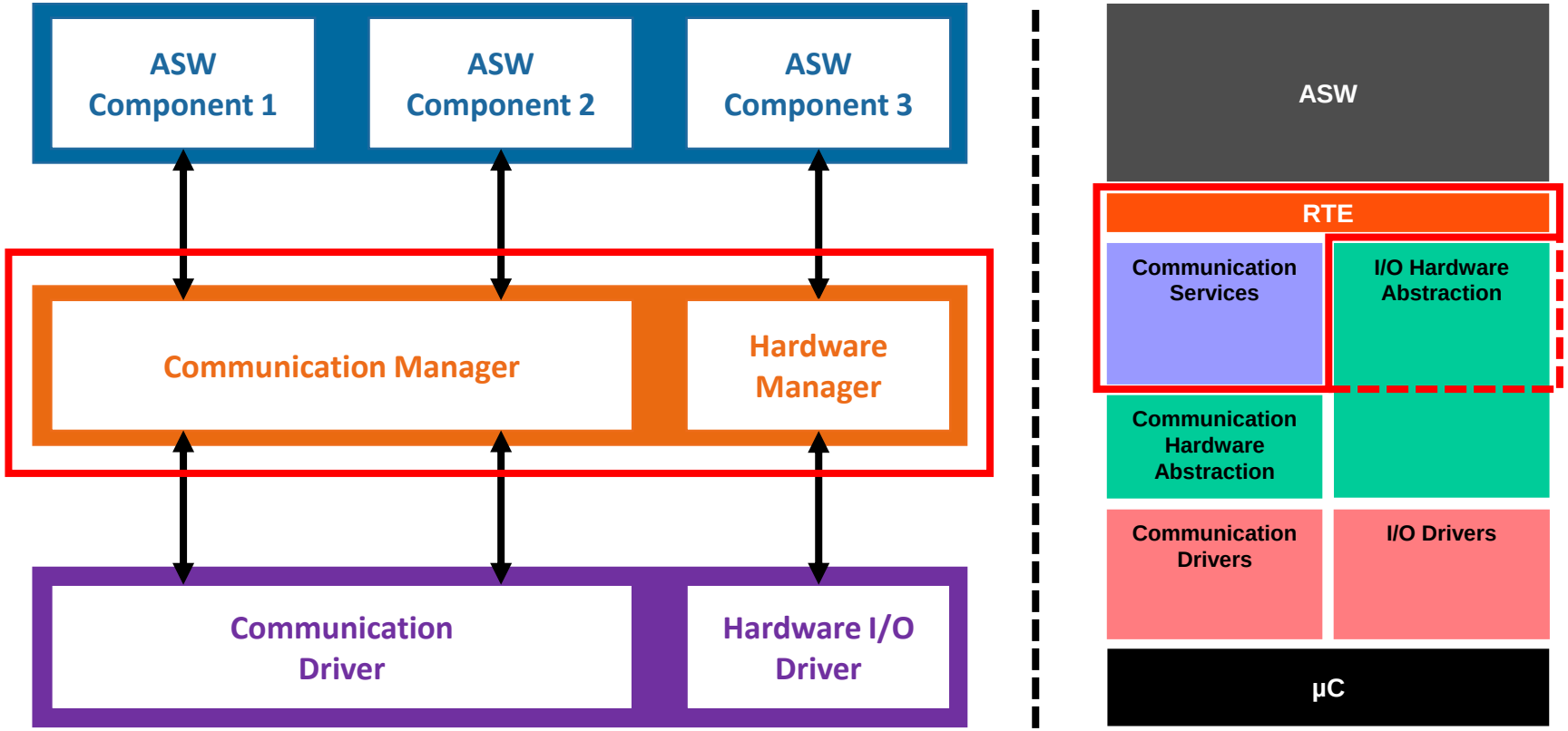
Middleware development



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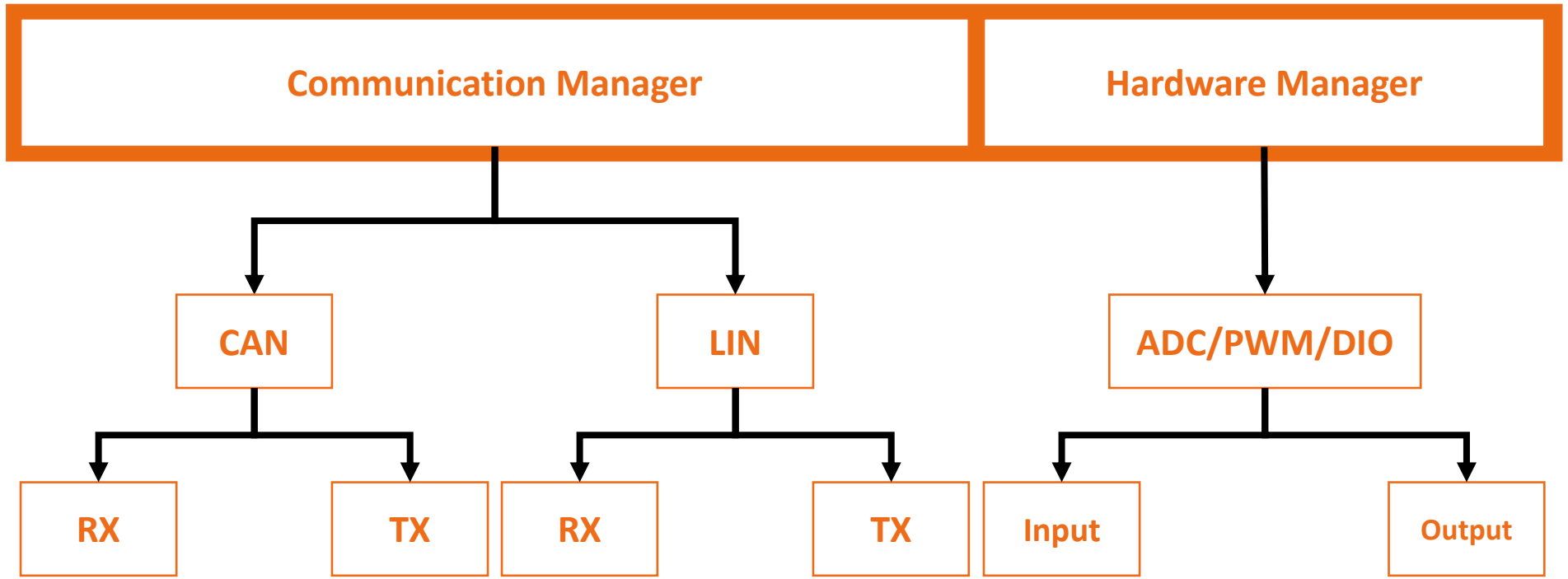
Middleware development



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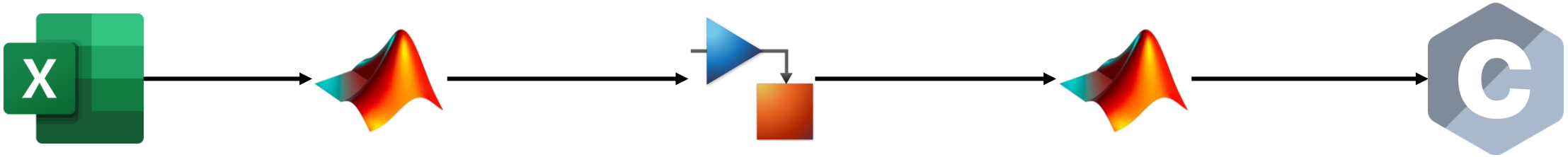
Middleware development



Data sheet:

- CAN/LIN
- ADC
- PWM
- DIO

Automation:

- Data-dictionary creation
- Modelling automation

Model Based Design:

- Code generation

Automation:

- ISO-26262 Qualification Process

Result:

- Safety-trusted C code
- ISO-26262 WP's

5. Results.

Project

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Project

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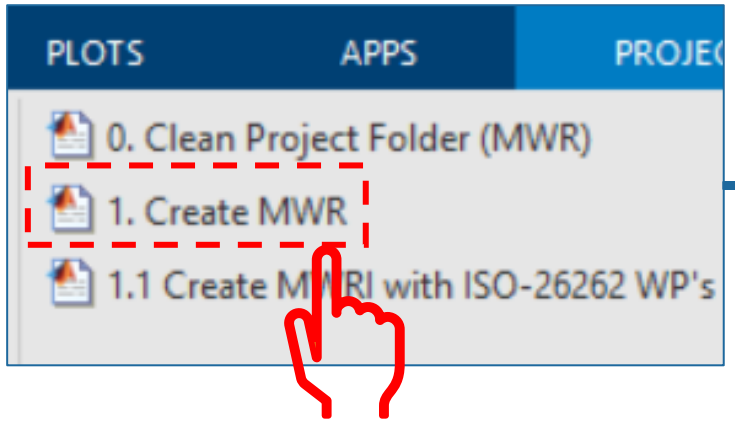
Project



MWR_InputModel.slx

MWR_InputDataDictionary.sldd

MWR_OutputModel.slx

MWR_OutputDataDictionary.sldd

MWR_InputModel_ert_rtw.zip

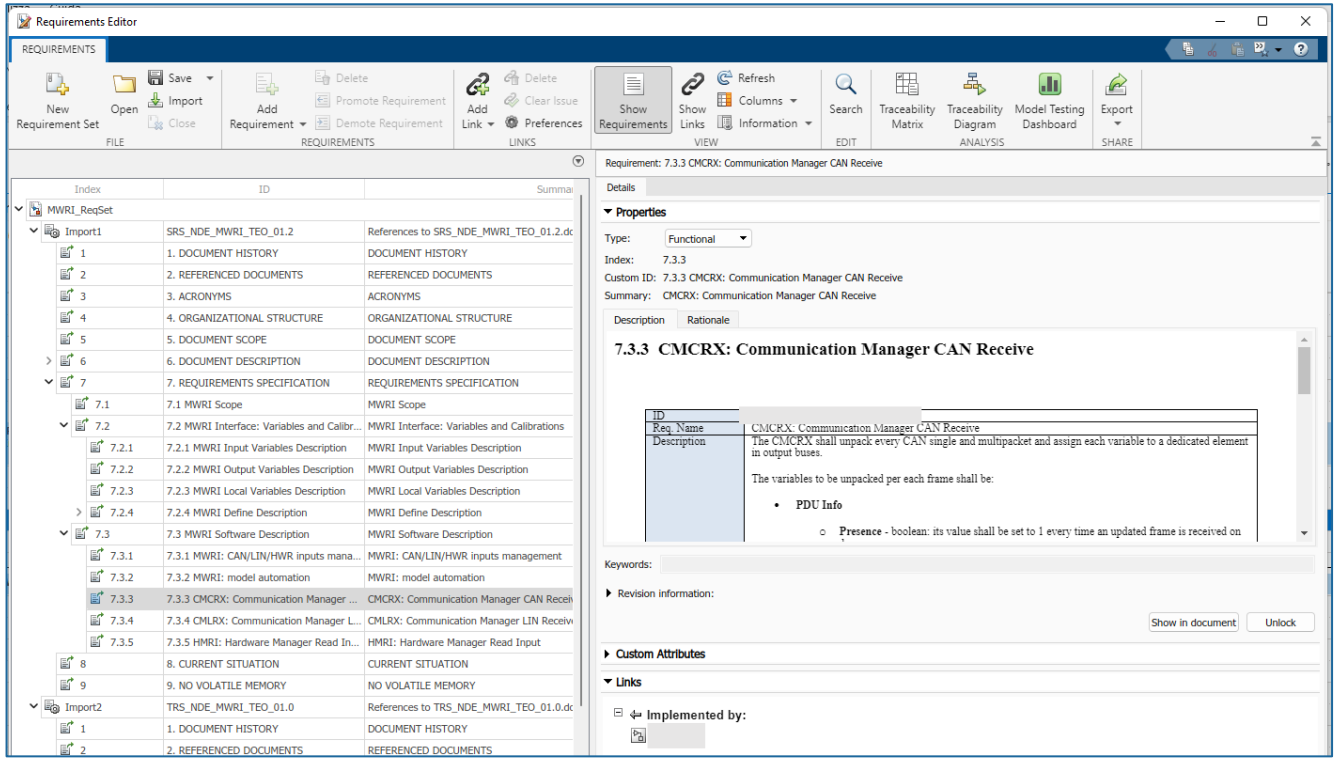
MWR_OutputModel_ert_rtw.zip

MWR_Input.zip

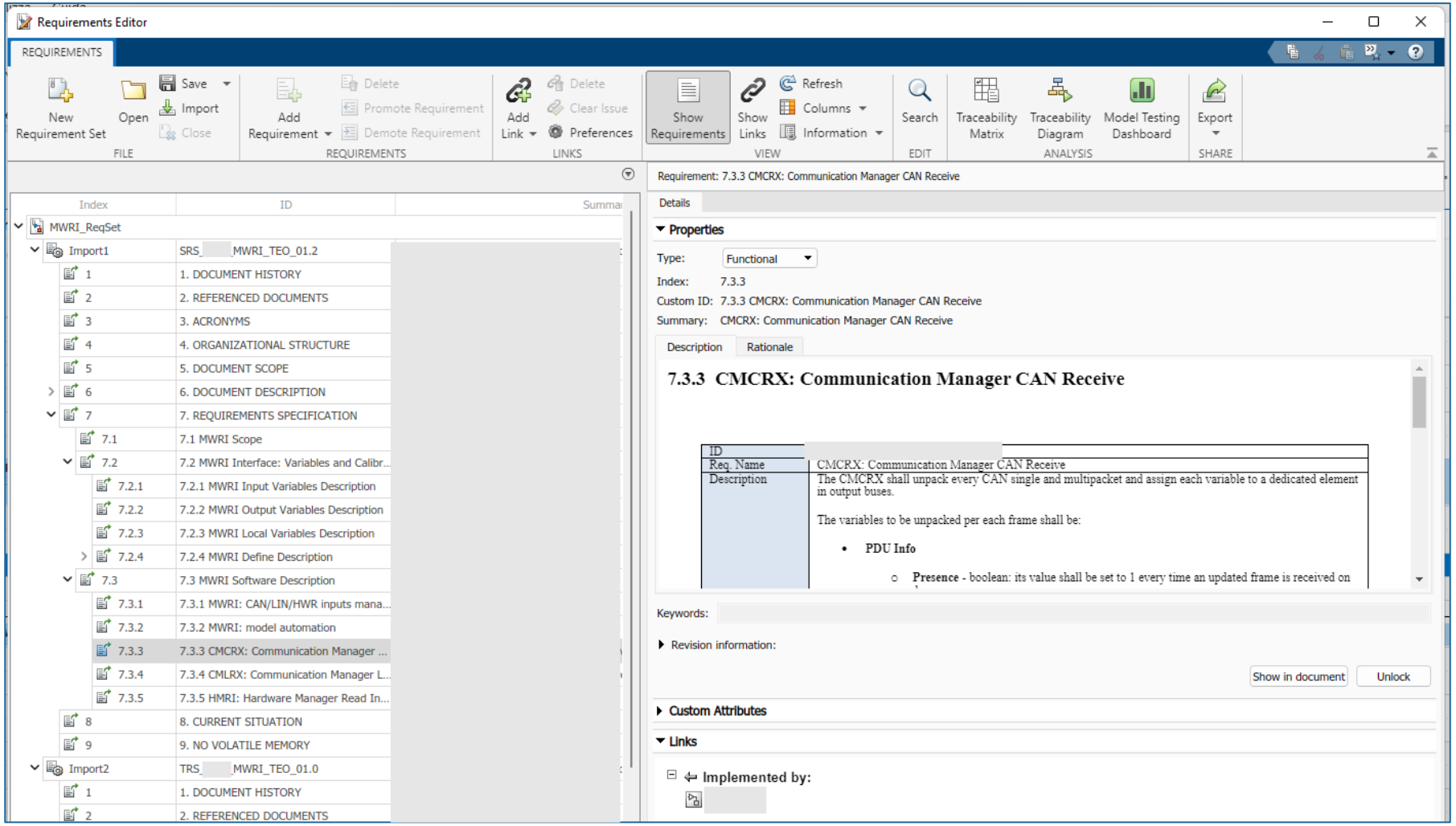
MWR_Output.zip

5. Results.

WP's | Software requirements specification



5. Results.



5. Results.

WP's | Test cases and test reports


MWRI- ISO-26262 TRS

[TRS_MWRI_TEO_01.0.docx] Version: 01.0

MWRI - ISO-26262 Test Requirement Specification

Report Generated by Test Manager

Title: MWRI Equivalence Test Report
Author:
Date: 18-Sep-2022 20:46:47

Test Environment

Platform: PCWIN64
MATLAB: (R2022a)

Summary

Name	Outcome	Duration (Seconds)
Results: 2022-Sep-18 20:31:51	5	689.516
MWRI_TestFile_18_Sep_2022_20_30_22	5	689.516
MWRI_TestSuite_Equivalence	5	689.517
MWRI_TestCase_Equivalence	5	689.517
Iteration1		253.752
Iteration2		109.339
Iteration3		106.609
Iteration4		105.97
Iteration5		110.624

5. Results.

Results: 2022-Sep-18 20:31:51

Result Type: Result Set
Parent: None
Start Time: 18-Sep-2022 20:33:38
End Time: 18-Sep-2022 20:45:07
Outcome: Total: 5, Passed: 5

Aggregated Coverage Results

Analyzed Model	Sim Mode	Complexity	Decision	Condition	MCDC	Function	Function call	Execution
MWRI_model	ModelRefSIL	380	98%	98%	100%	100%	100%	100%
MWRI_model	Normal	1204	100%	100%	100%	--	--	100%
	SIL	30	--	--	--	0%	--	0%

Back to Report Summary

MWRI_TestFile_18_Sep_2022_20_30_22

Test Result Information

Result Type: Test File Result
Parent: Results: 2022-Sep-18 20:31:51
Start Time: 18-Sep-2022 20:33:38
End Time: 18-Sep-2022 20:45:07
Outcome: Total: 5, Passed: 5

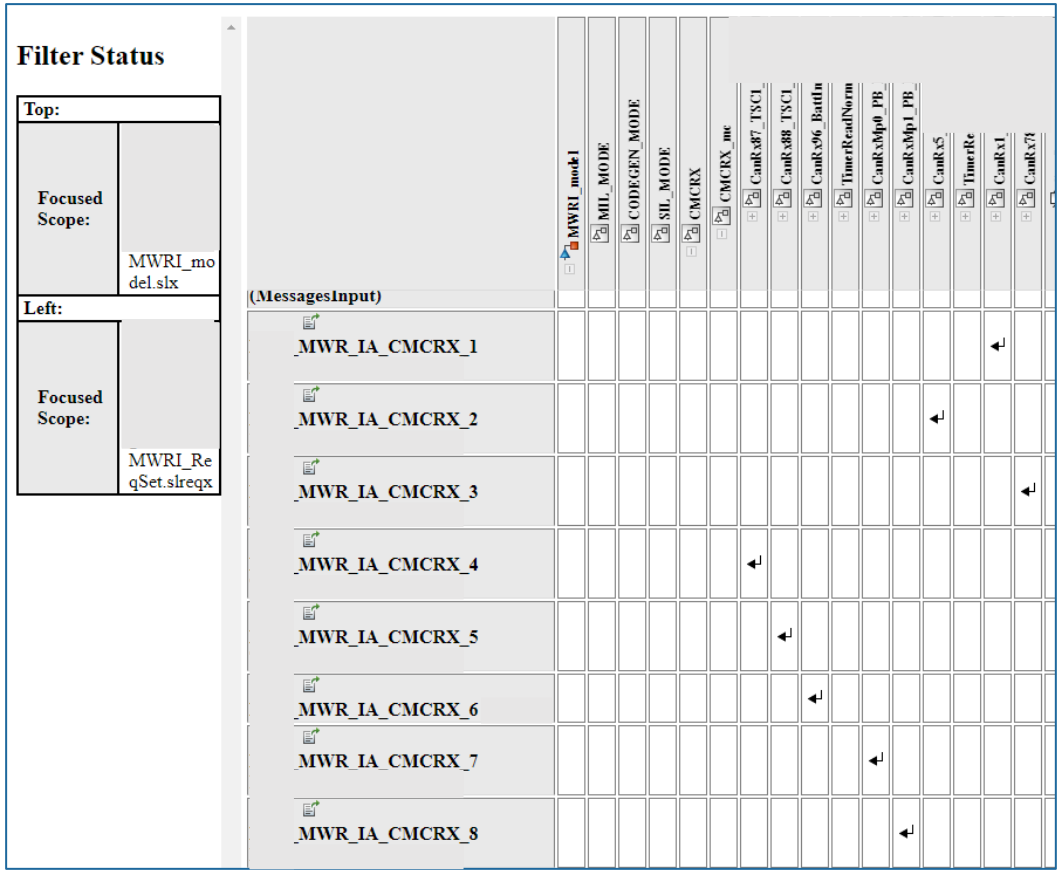
5. Results.

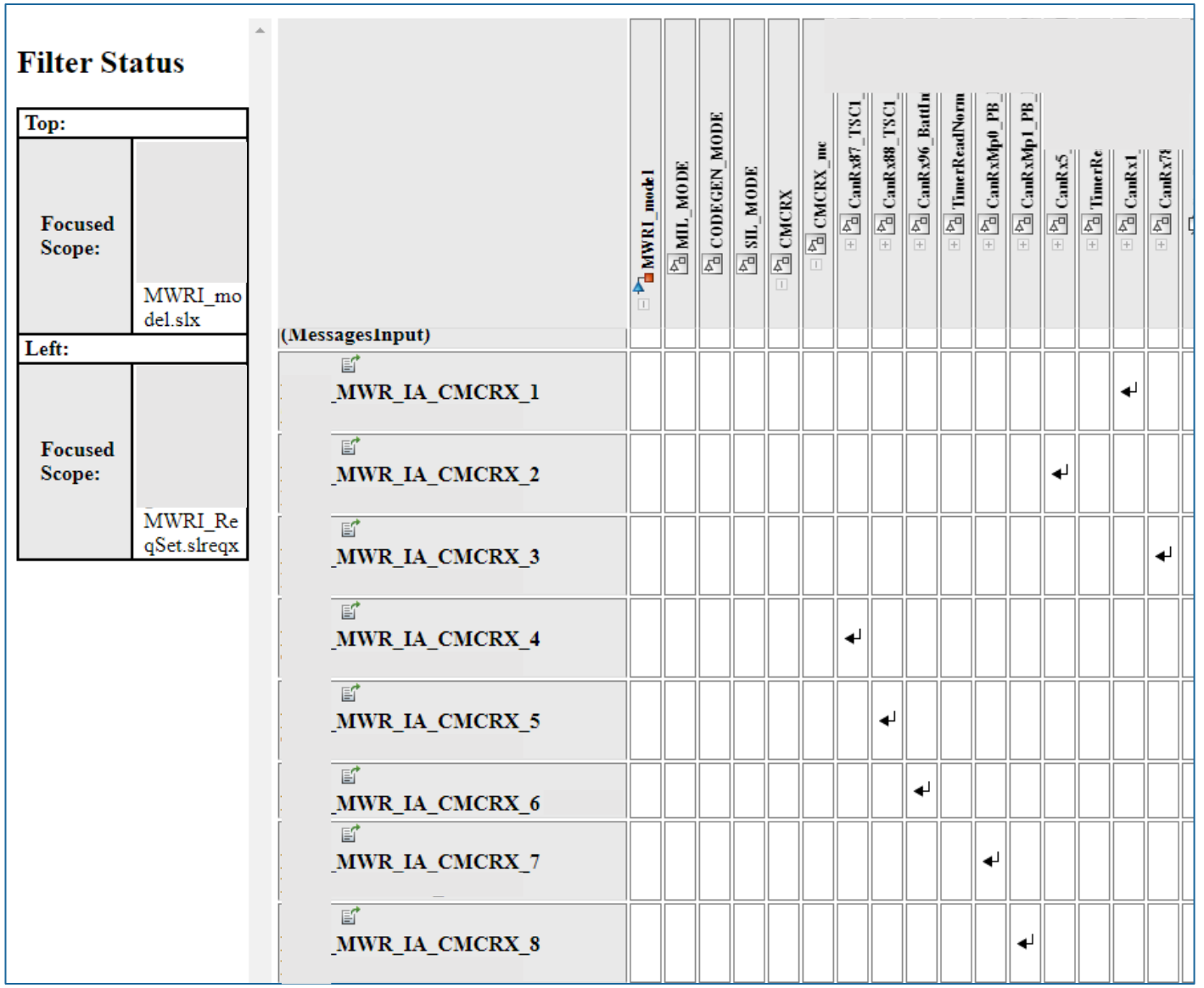
Equivalence Comparison

Name	Abs Tol	Rel Tol	Lead Tol	Lag Tol	Max Diff	Data Type 1	Units 1	Sample Time 1	Data Type 2	Units 2	Sample Time 2	Interp	Sync	Link to Plot
[redacted]	0	0	0	0	0	uint32		0.005	uint32		0.005	zoh	union	Link
Ok	0	0	0	0	0	boolean		0.005	boolean		0.005	zoh	union	Link
	0	0	0	0	0	boolean		0.005	boolean		0.005	zoh	union	Link
	0	0	0	0	0	boolean		0.005	boolean		0.005	zoh	union	Link
1	0	0	0	0	0	uint8		0.005	uint8		0.005	zoh	union	Link
xP	0	0	0	0	0	uint8		0.005	uint8		0.005	zoh	union	Link
xP	0	0	0	0	0	uint8		0.005	uint8		0.005	zoh	union	Link

5. Results.

WP's | Traceability matrix





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Thank you!