

Leading International Supplier of Highly Advanced Solutions

... for Electrification, Thermal Management and Sustainable ICE

▶ We Shape Future Mobility

Development partner to all major passenger and commercial vehicle OEM worldwide.

Systems supplier of crucial **powertrain** and **air conditioning** technologies with TOP 3 market position in core products.

Technological diversity for effective and fast climate protection.



How it Started ...

MAHLE Production in the early 1920th



... what is Today

Automated Electronics Production

About the presenters



Luciën Stuivenvolt

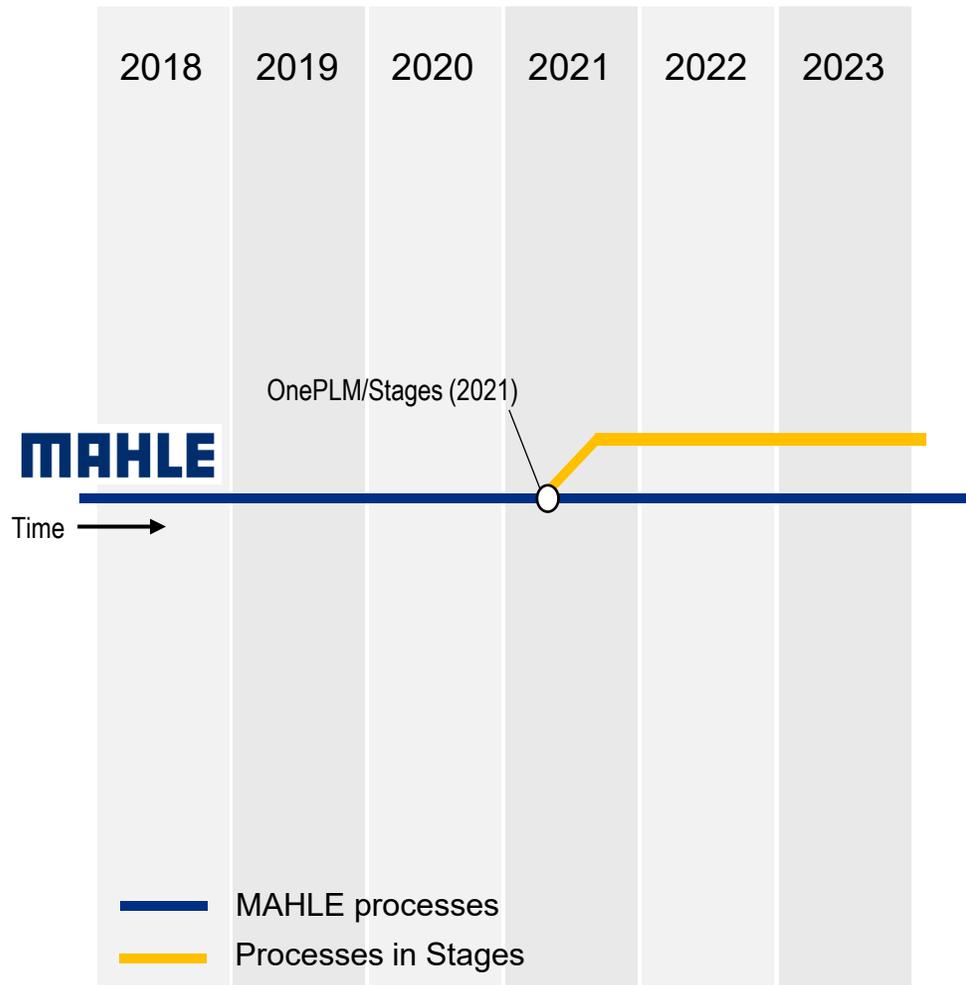
- Head of ASPICE assurance, Cyber Security and Functional Safety at MAHLE, Spain.
- Over 30 years of experience in R&D Quality.
- Since 2009 in the Automotive market and for the last almost 10 years working on implementing the ASPICE requirements at MAHLE.
- Achieved an ISO 9001 certification till recently an ASPICE level 3 certificate.



Cyril Stock

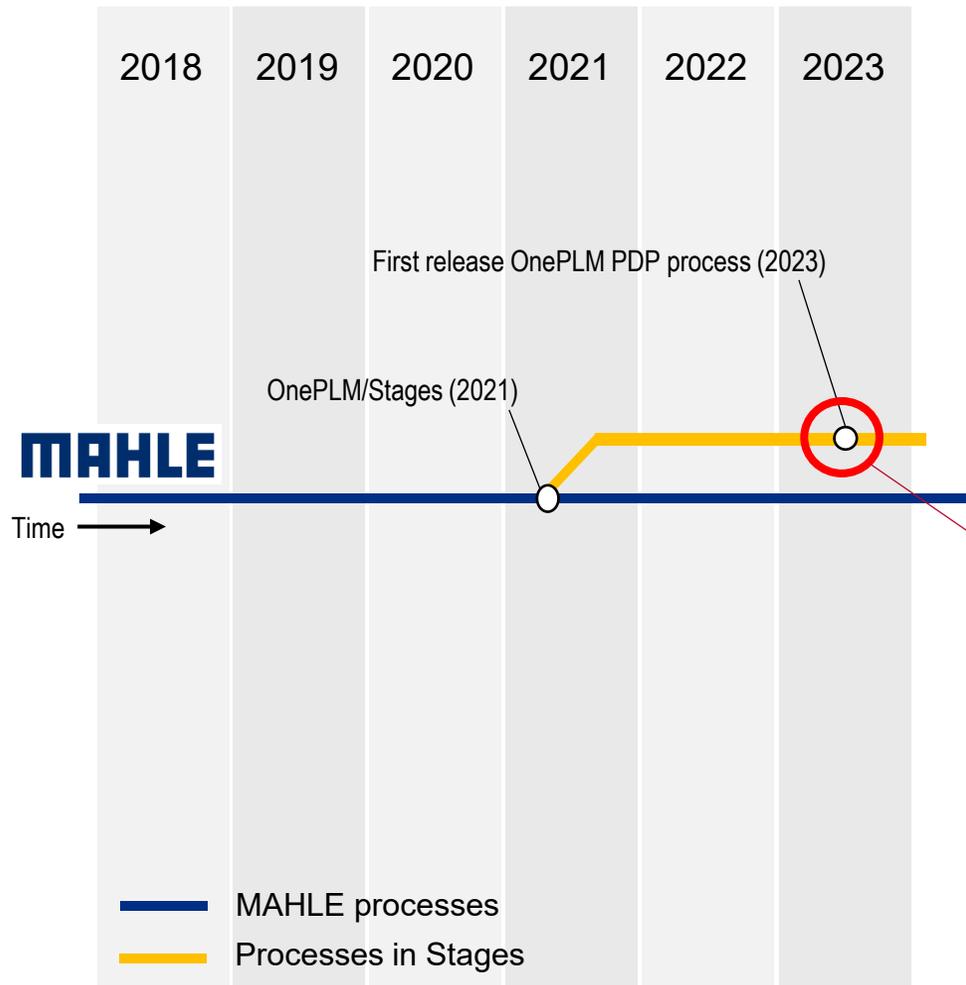
- Lead Engineer for R&D functions at MAHLE, Germany with almost 20 years of experience in the Automotive Industry.
- Of which 15 years of experience in product development as development engineer and project technical leader.
- Since 2020, part of the MAHLE process, methods, and tools team working as Lead Architect for process modeling in Stages.
- Achieved the ISO/SAE 21434 certification.

Process modeling in Stages, how it actually started?



- Company wide program to transform the fragmented PLM landscape into one PLM.
- Harmonization and standardization of PLM of processes, methods and tools.
- Due to the complexity of the Product Portfolio (from mechanical component to complex system with MECH, HW and SW components) and the external norms to comply to (e.g.: ASPICE, Cybersecurity, Functional Safety...) need of a strong process management with process tailoring possibilities.
- Stages as process modeling and process management tool.

Process modeling in Stages, how it actually started?



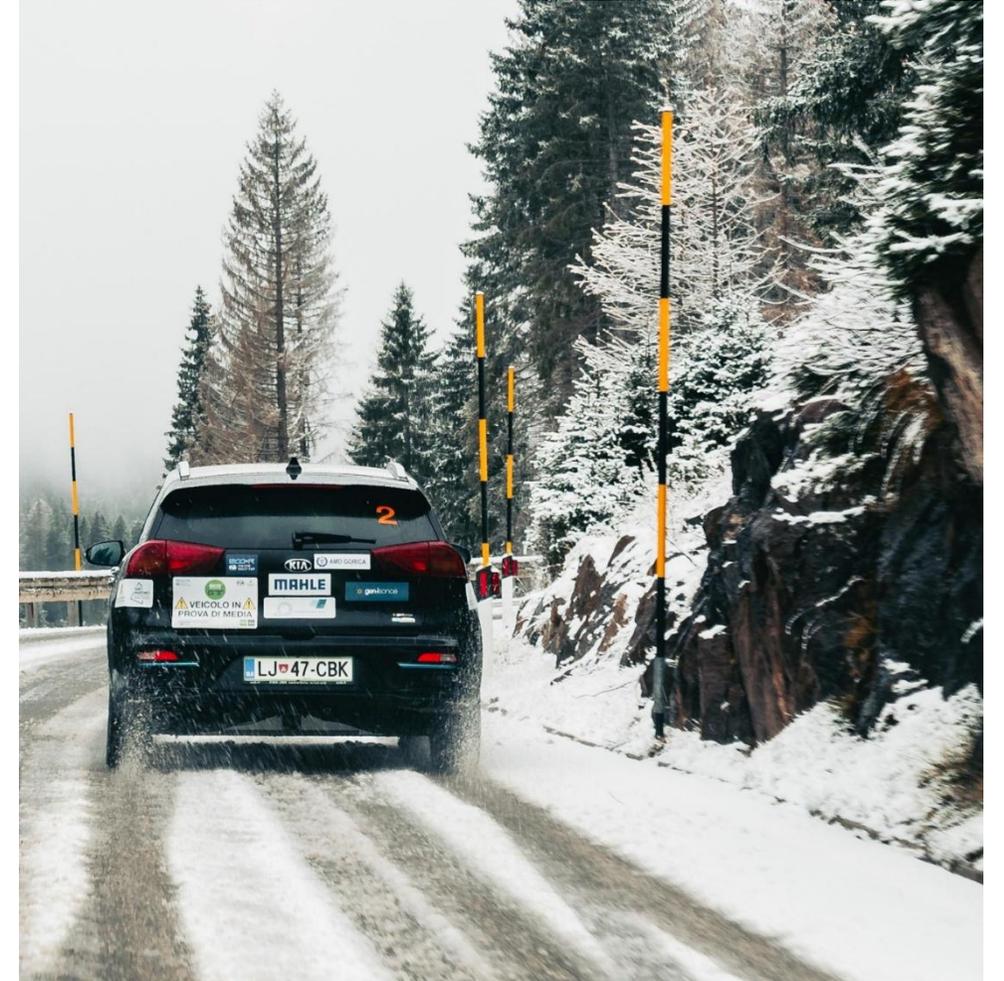
- Release of the first version of the MAHLE-wide harmonized Product Development Process (PDP) in Stages:
 - Several MAHLE specific domains/disciplines added.
 - Few MAHLE specific practices added.
 - Complete PDP lifecycle with phases and milestones identifying all the works products with required quality levels.



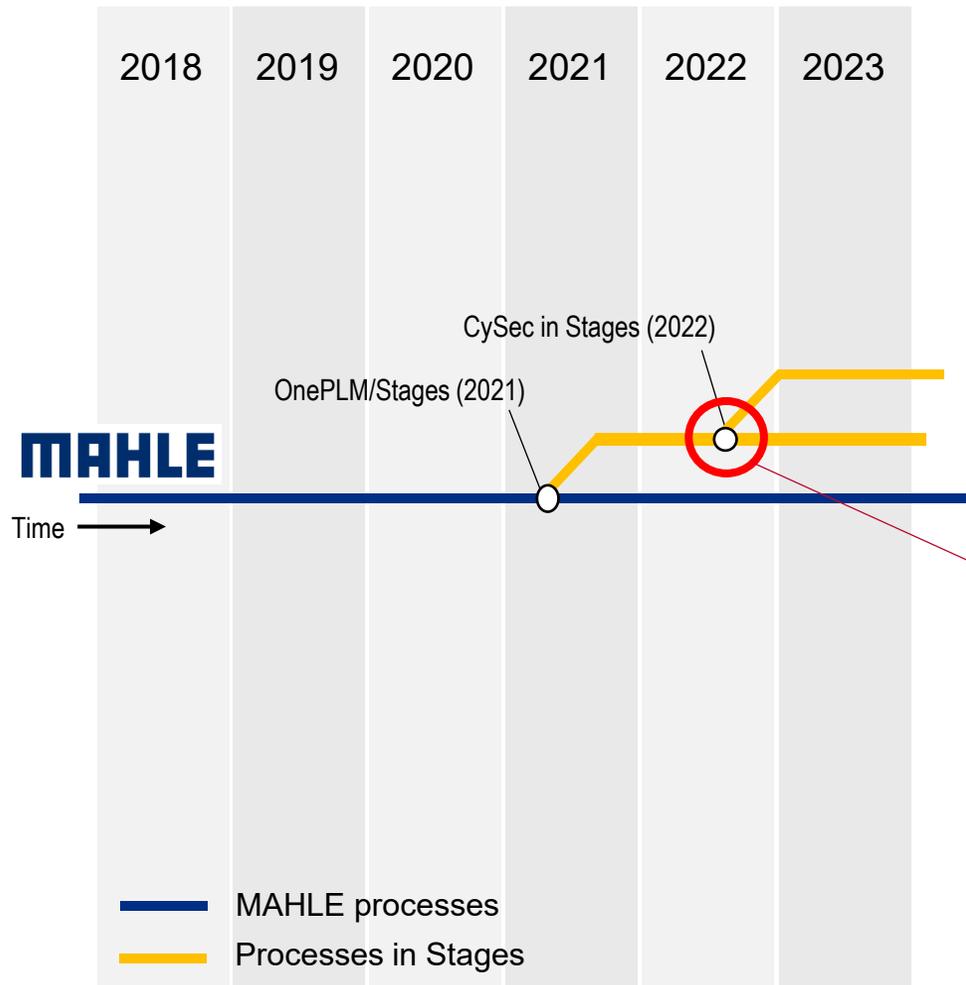
Process modeling in Stages, how it actually started?

Achieving a first release was already a big success...

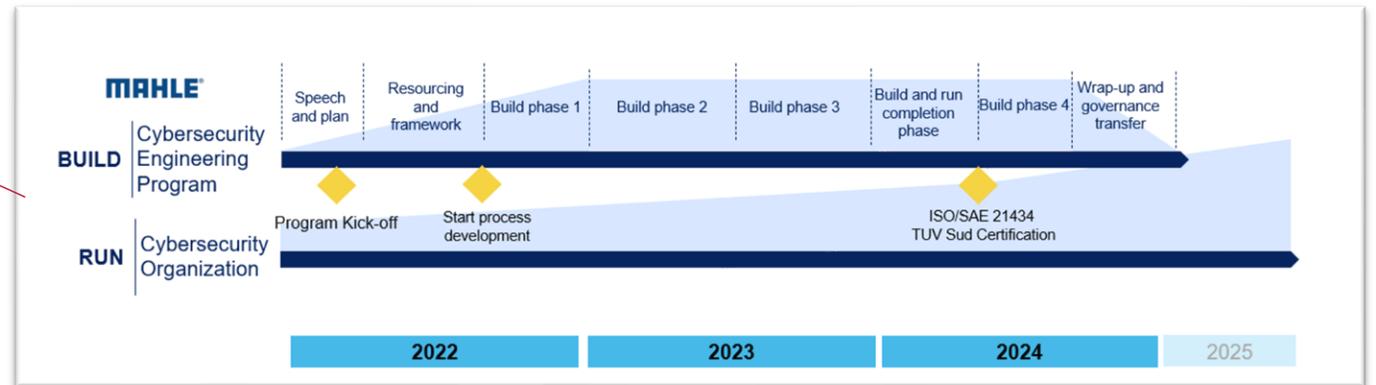
... but only a step in our journey towards cybersecurity engineering and ASPICE certification.



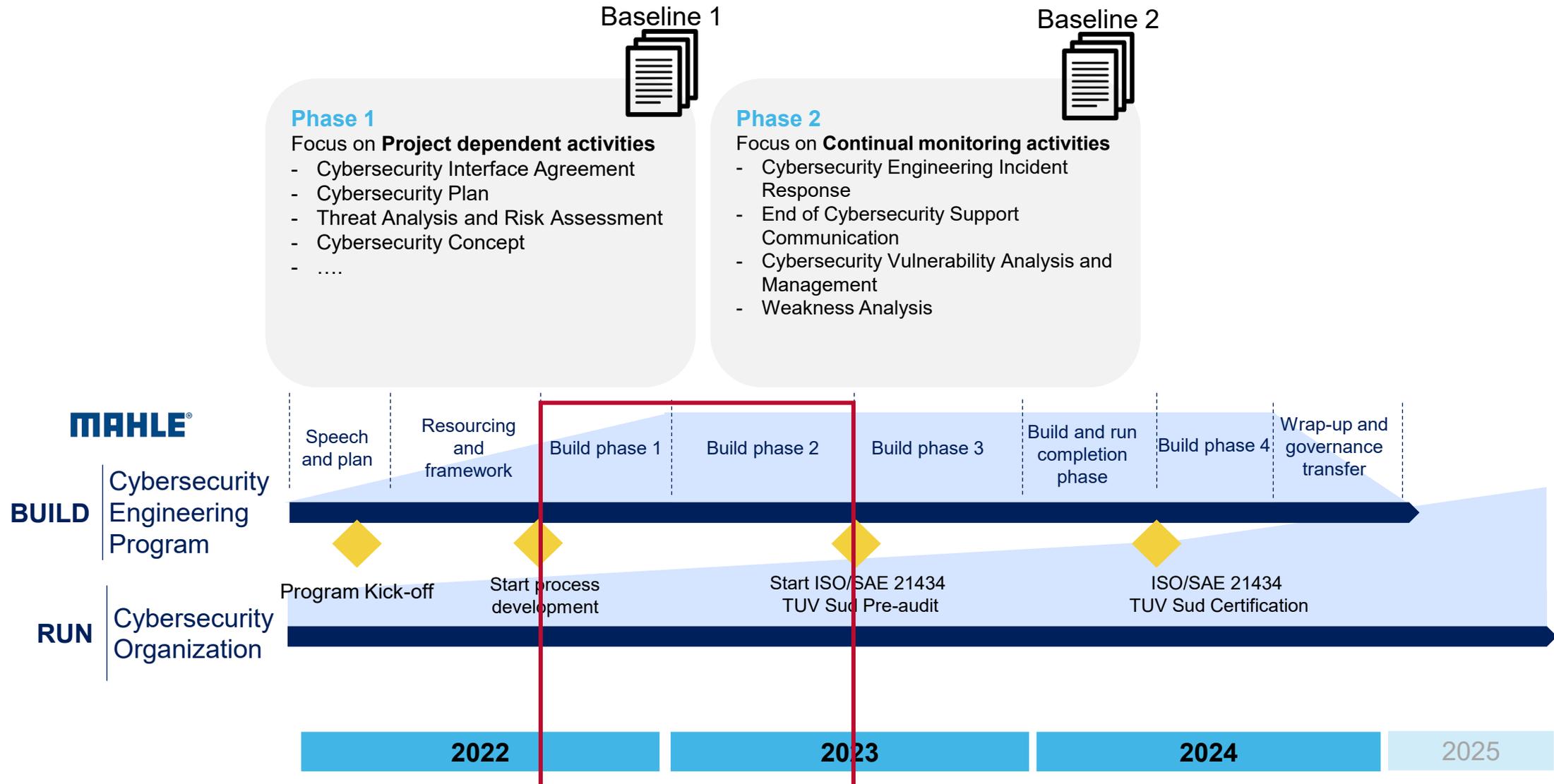
Early wins, the ISO/SAE 21434 certification



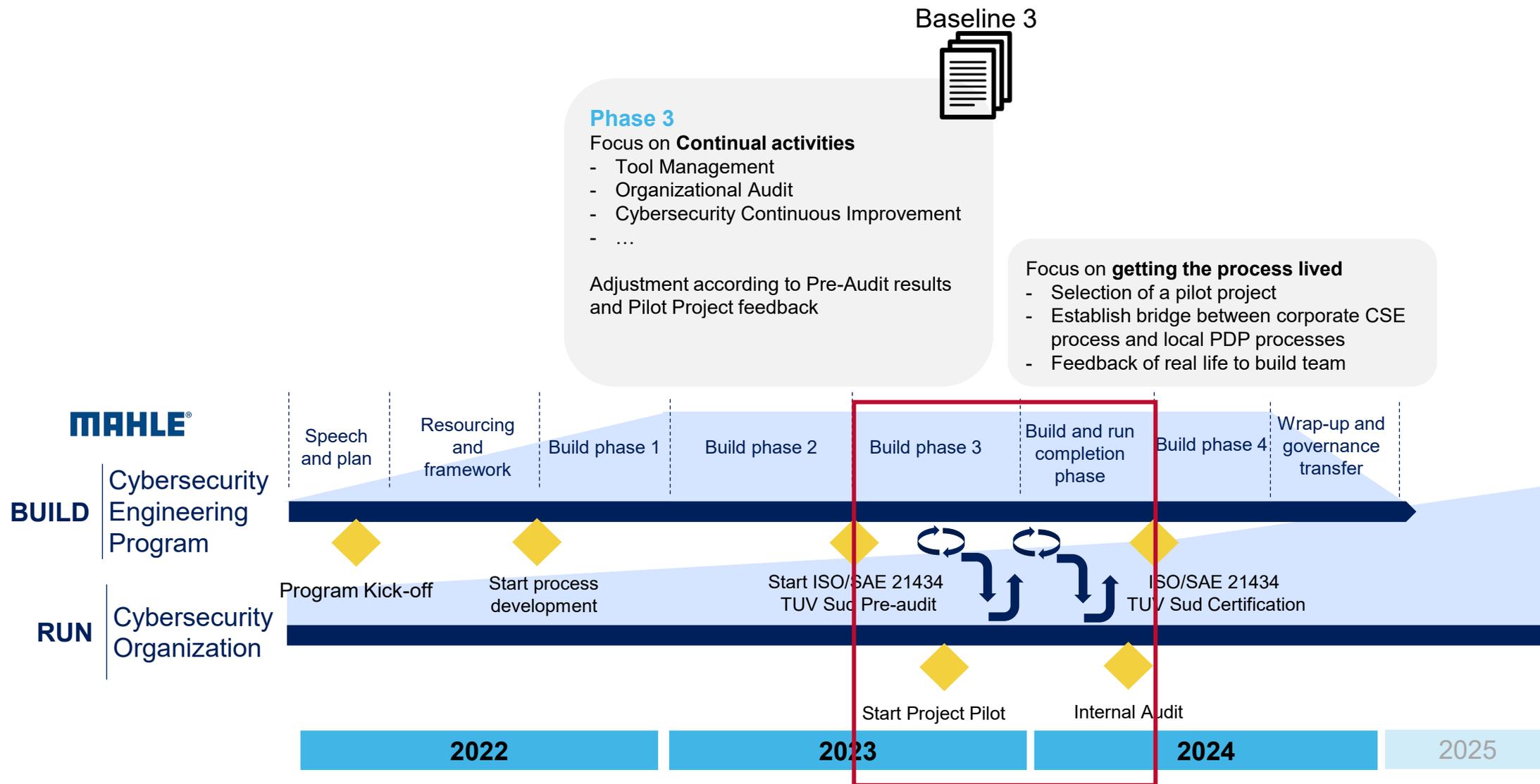
- From July 2024 on, compliance to UN R155 - Cyber security and cyber security management system was mandatory for new vehicle registration by OEMs.
- MAHLE set in 2022 a program to achieve during 2024 an ISO/SAE 21434 certification.



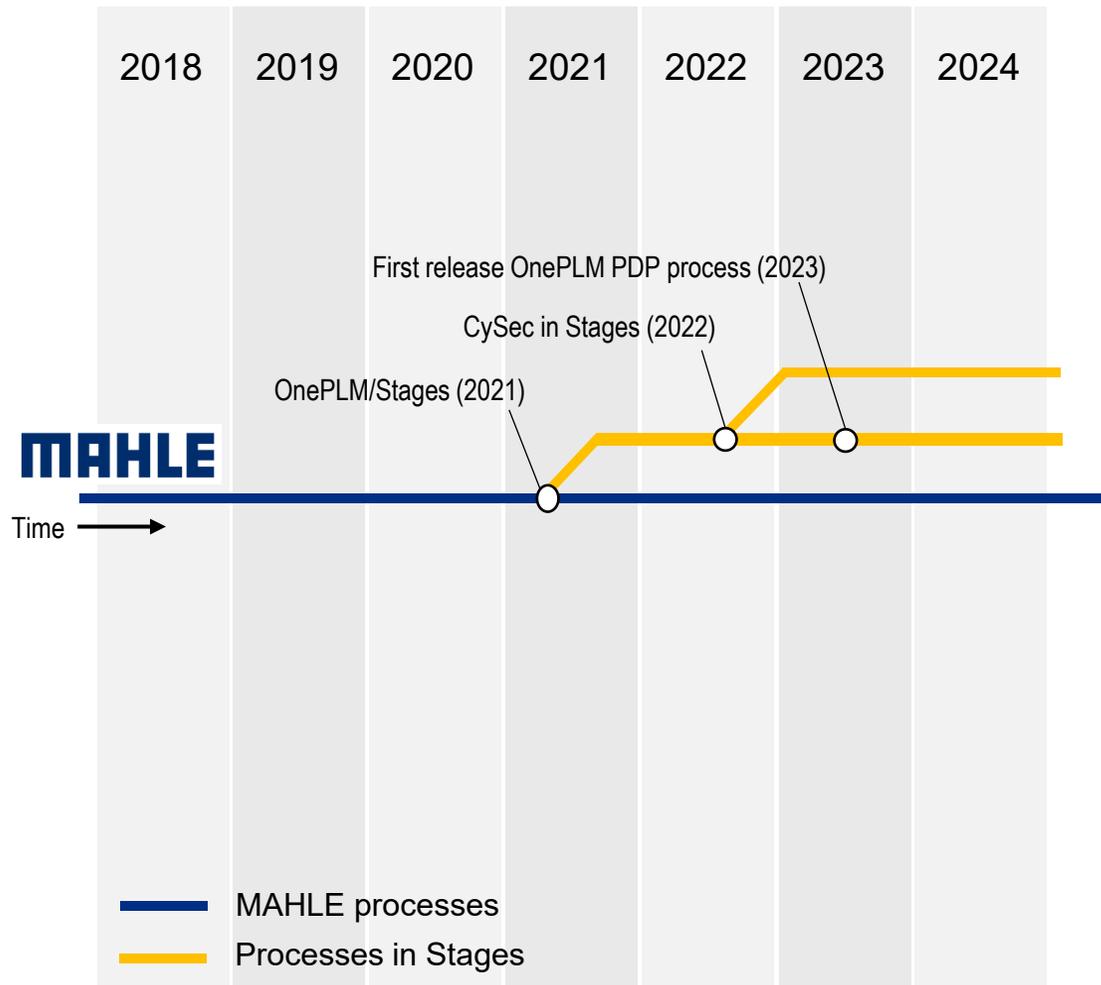
Early wins, the ISO/SAE 21434 certification



Early wins, the ISO/SAE 21434 certification



Early wins, the ISO/SAE 21434 certification



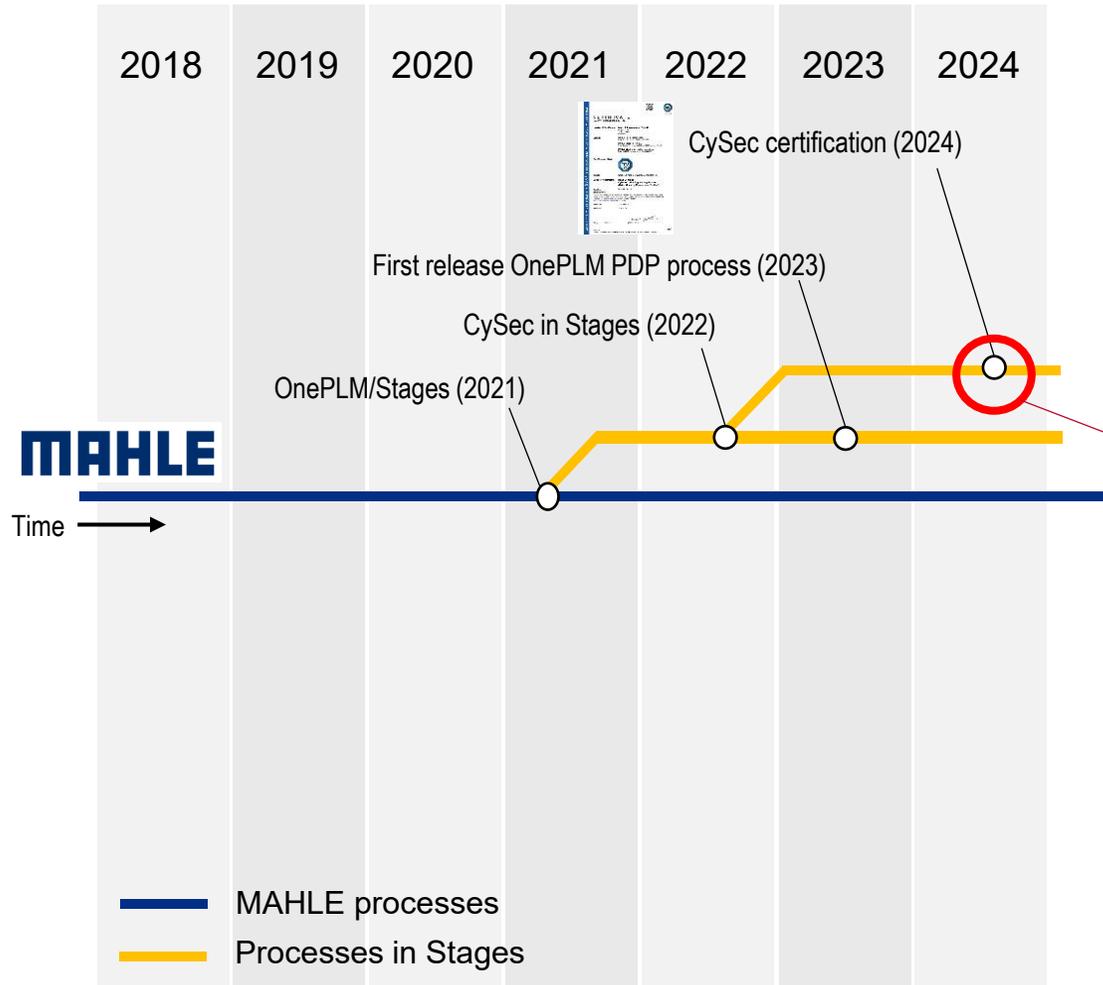
- ✓ Full project and organizational cybersecurity engineering process landscape modeled
- ✓ Process interfaces to System, Software, Purchasing and Manufacturing Engineering modeled.
- ✓ Link to defined work instructions and templates.
- ✓ Compliance to ISO/SAE documented.



- ✓ Link established between the modelled process in Stages and the local PDP that engineering teams are following.

- Strategy of the audit was:
 - For each requirement starting by showing the process in Stages and the associated methodologies and templates.
 - Then showing evidence that the process is used through pilot project examples.

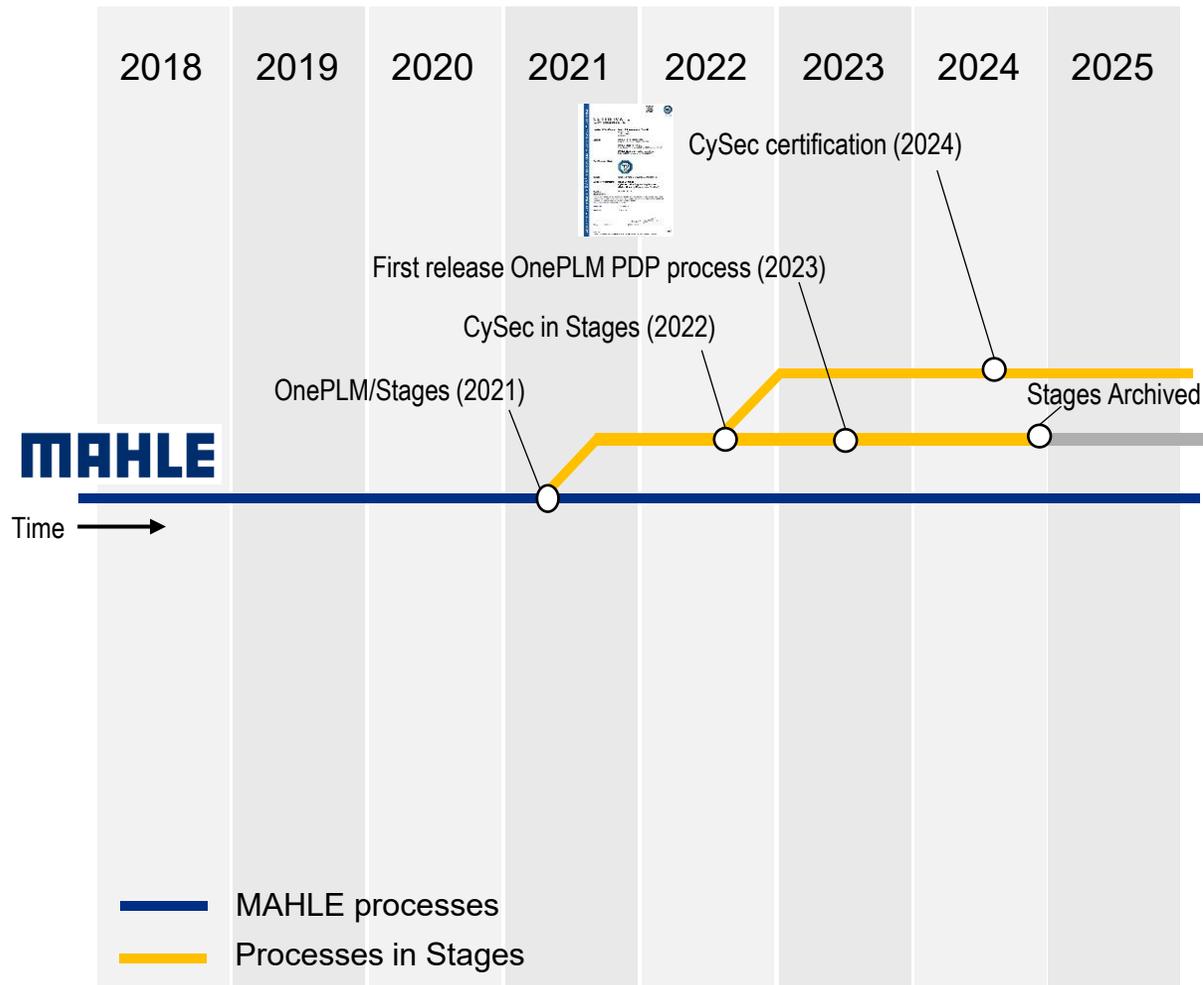
Early wins, the ISO/SAE 21434 certification



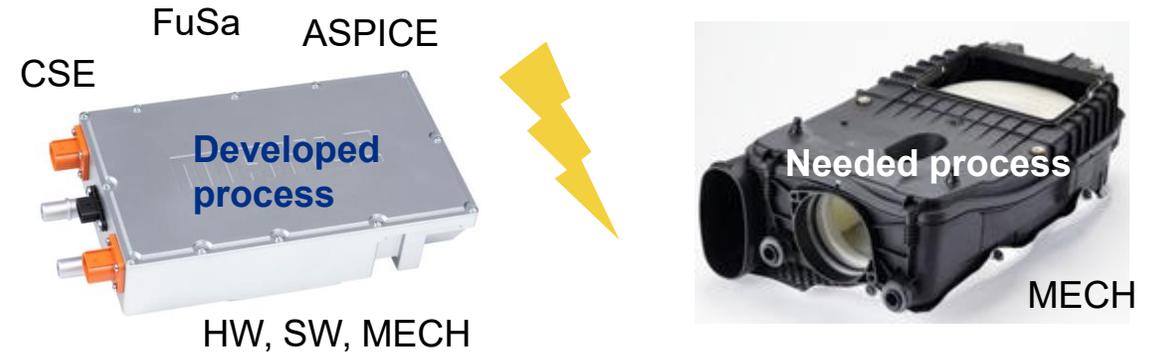
ISO/SAE 21434 certification passed successfully in July 2024.



2024, a wind of change



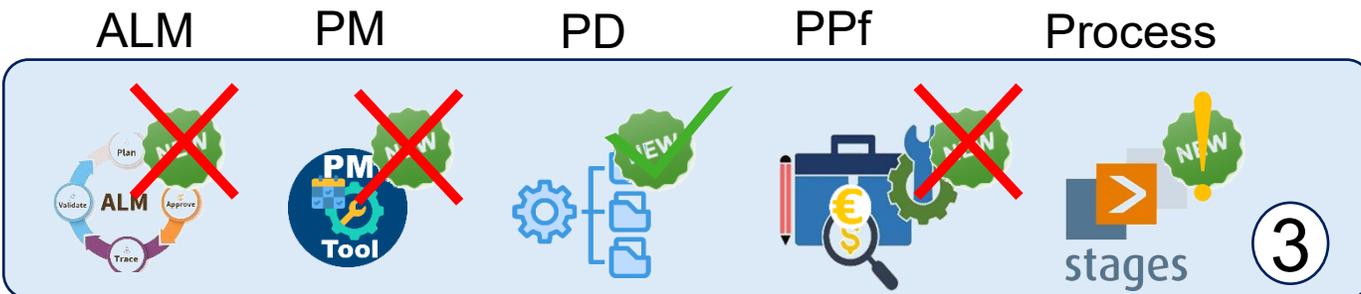
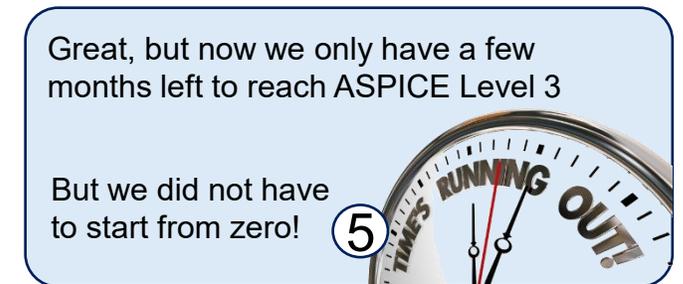
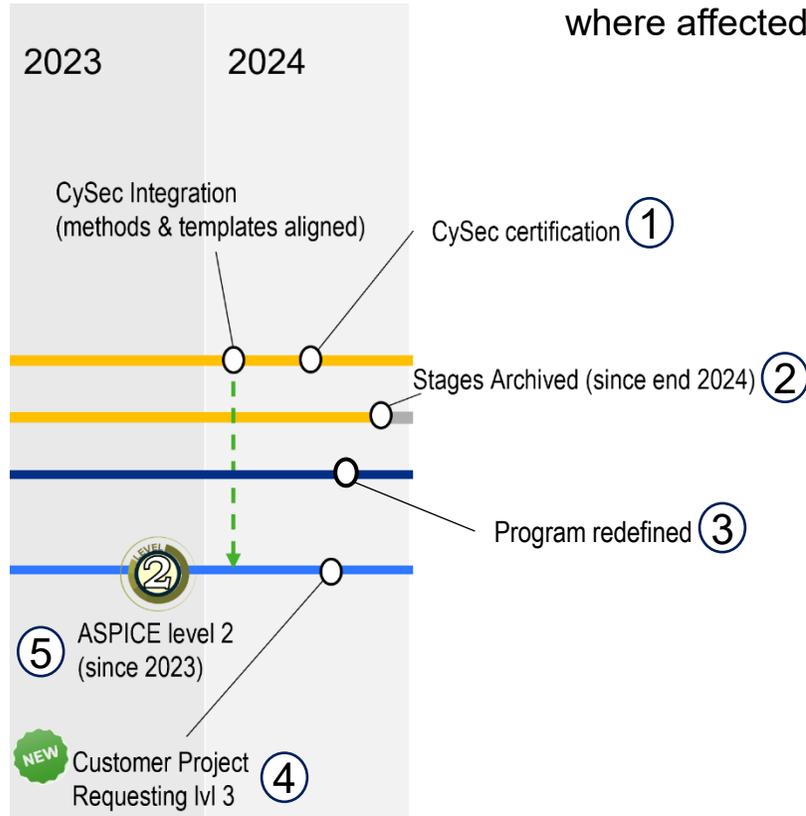
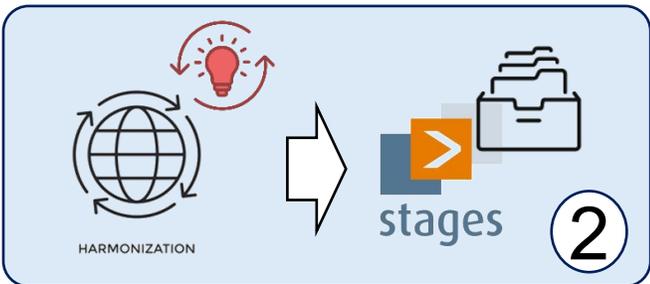
- End of 2024 the harmonized PDP was planned to be rolled out in a first business unit.
- Pilot projects raised a major issue: the defined tailoring concept was not capable to reduce the complexity of the modeled processes to the needs of the development teams.



The concept of one single harmonized PDP reached its limits; redefinition of the program was inevitable.

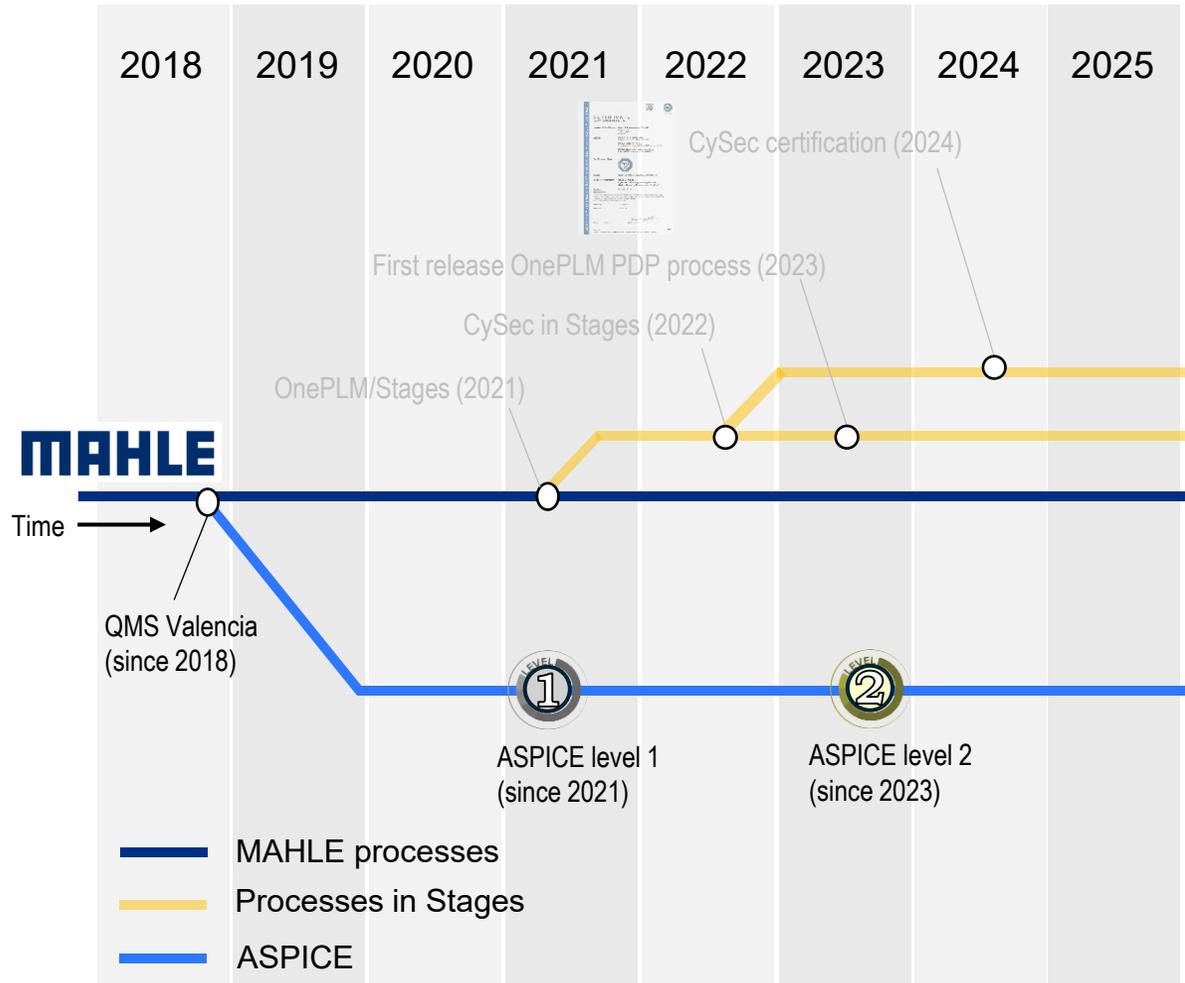
What happened in 2024?

2024 in a nutshell and how process and tools where affected



- ✗ New tool implementation rejected
- ✓ New tool implementation continued
- ! New tool implementation not rejected

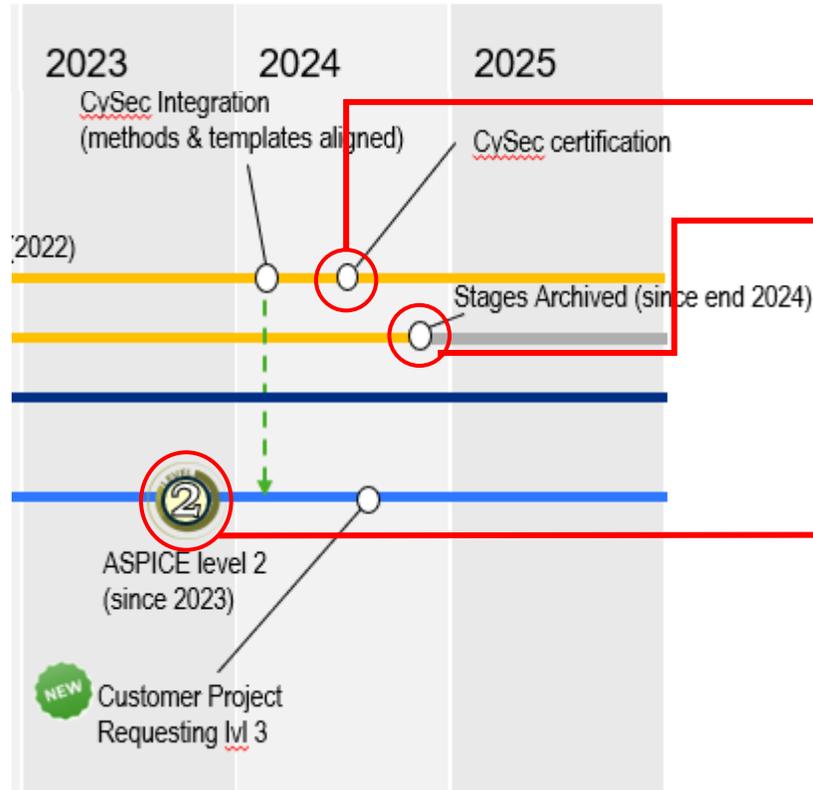
ASPICE, A journey since 2018



- ✓ 2018: Started to introduce the ASPICE requirements in our development processes and projects
- ✓ 2018: Chosen to implement Polarion as main ALM tool
- ✓ 2021: ASPICE level 1 achieved
- ✓ 2023: ASPICE level 2 achieved

Steady growth in maturity over the years
Many good practices implemented and lived

First step (to success)



Early 2025 – Some decisions had to be taken



- ✓ Successful process model demonstrated in Cyber Security audit
- ✓ Lot of (harmonized) know how in the Archived processes
- ✓ Enhanced tool capabilities, best fit to process definition needs



- ✓ Many good practices available in our ALM tool (via Project template)
- ✓ Successfully supported multiple ASPICE level 2 assessments
- ✓ However, weak on process and method definition
- ✓ Process maintenance lacking



- Combine strengths of both (Stages and ALM experience)
- Save on cost and time – avoid re-doing things again



- Improve weakness on Process maintenance (pitfall prevention)
- Develop & Implement a tailoring approach



Project Template (ALM)

Introduction

Re-use of existing information
In search for a smart solution



- ✓ Our Project Template defines a predefined Project set-up
- ✓ It supports the Project team and facilitates to all Domain development
- ✓ A collective and controlled set of Work Products and more (see next slide)
- ✓ A continues improving & adapting environment, started in 2018
- ✓ It's setting the defined approaches and way of working

Project Template (ALM)

Basic set-up



Project Template

- Folder Structure ①
- Checklists ②
- Work Items & WI flows ③
- Standard Reports ④
- Pre-filled Plans & Templates
- Configuration Items
- Roles & Role descriptions

Re-use of existing information
In search for a smart solution

Home 1

- Resources
- ▶ Planning
- ▶ Requirements
- ▶ Development
- ▶ Testing
- ▶ Changes and Issues
- ▶ Quality and Safety

Work Items

- ▶ Documents & Pages
- ▶ Plans
- ▶ Test Runs
- ▶ Baselines
- ▶ Collections
- ▶ Monitor

4.2 Configuration Items 2

All Configuration Items (CIs) are defined (reviewed and accepted) and only the CIs which are applicable in the current phase

F - All CIs are defined and created (when applicable) as defined in the plan
 L - Most of the CIs are defined and created (when applicable) as defined in the plan
 P - Some CIs are defined and created (when applicable) as defined in the plan
 N - CIs are not available or are not created (when applicable) as defined in the plan

Status	In Review
Check Resolution	
Remark	

Workflow Details 3

Report Content 4

Stake. Reqs.	System Reqs.	System Test Cases	Domain Reqs.	Domain Test Cases
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Project Template (ALM)

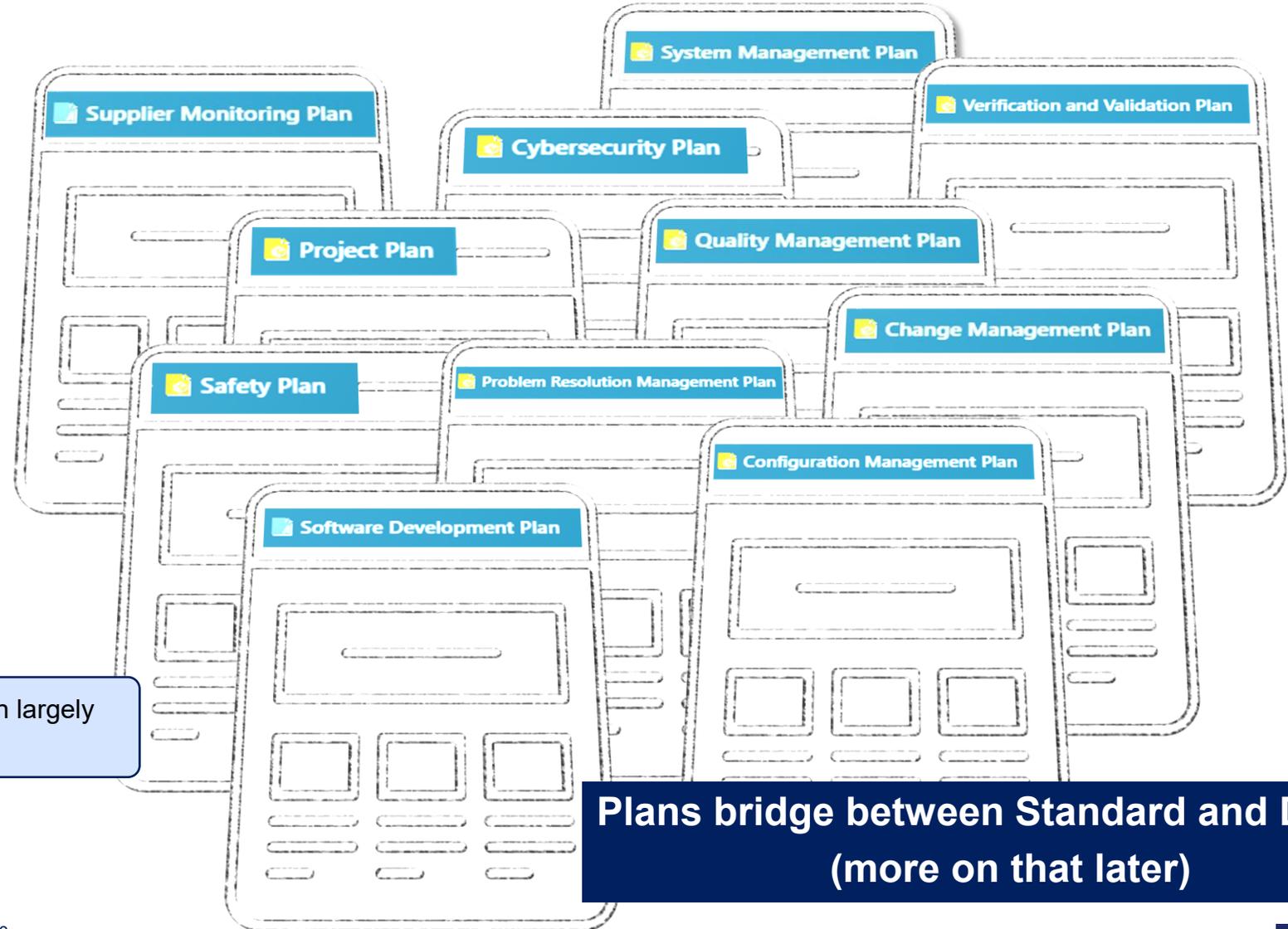
Pre-defined Plans

Re-use of existing information
In search for a smart solution



Project Template

- Folder Structure
- Checklists
- Work Items & WI flows
- Standard Reports
- **Pre-filled Plans & Templates**
- Configuration Items
- Roles & Role descriptions



All Plans have their own largely pre-defined template

**Plans bridge between Standard and Defined
(more on that later)**

Project Template (ALM)

Configuration Items & Roles

Re-use of existing information
In search for a smart solution



Project Template

- Folder Structure
- Checklists
- Work Items & WI flows
- Standard Reports
- Pre-filled Plans & Templates
- Configuration Items ①
- Roles & Role descriptions ②

Planning ▶ Configuration Management Plan



PDP-24794 [CMP] Configuration Management Plan ①

Description: This Configuration Management plan defines how to establish and maintain the integrity of all the work products of this project and make them available to concerned parties.
Quality Criteria: PDP-24836 - [CMPR] Configuration Management Plan
[view Report](#)

Template:
Configuration Management Plan

Configuration Location:
Polarion > Project > Planning

Responsible:
Configuration Manager

All Plans Combined,
over 200 CI defined



MS-6911 - CM / Configuration Manager ②

Responsibility:

- Supports and trains the project team members and generates the needed
- Defines and maintains the CM process and ensure that all the necessary
- Follows the CM audit
- Reports the status of the configuration items
- Monitoring the Project work

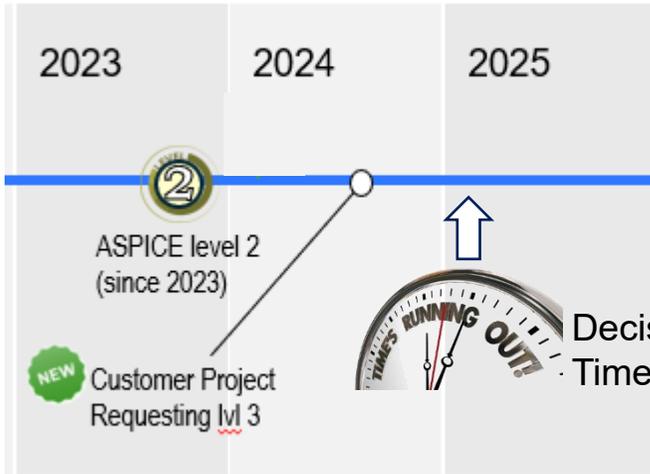
Authority:

- Without CI cannot how to apply the CM Process in the project
- Without CI cannot to ultimate decisions
- Escalate the decisions

Over 75 Project Roles defined

Summary on ALM experience

Good practices to keep



✓ Re-Use the good practices available



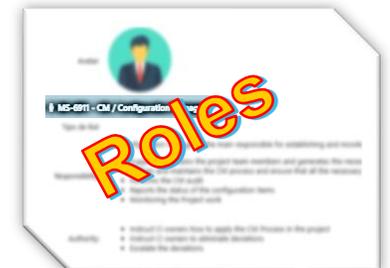
Pre-Defined Plans



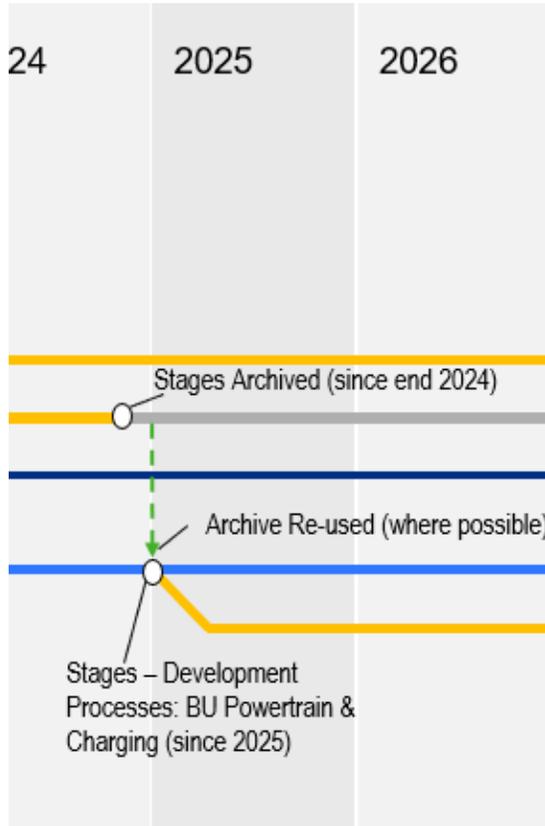
Configuration Items



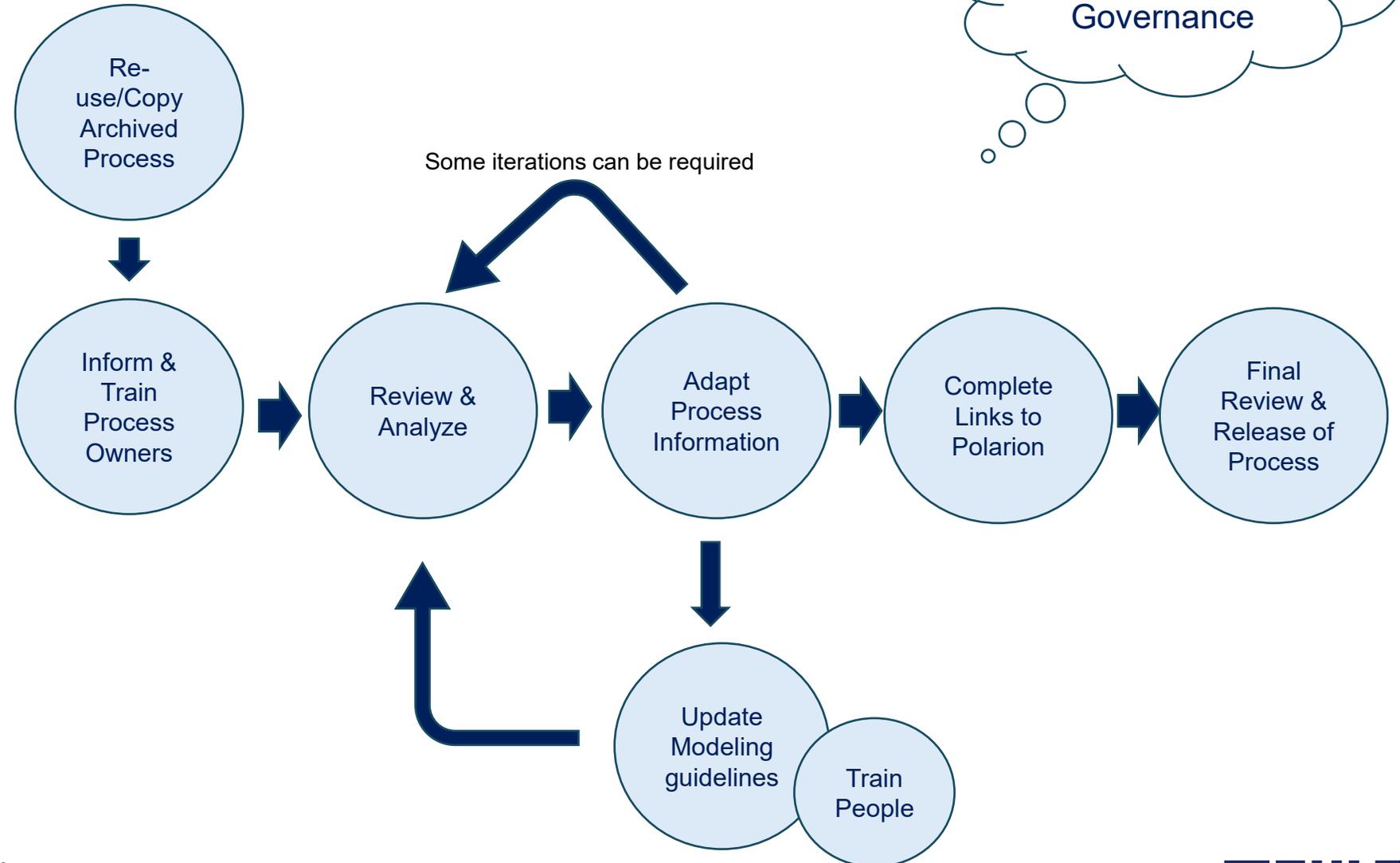
Roles



Re-use of Archived Processes

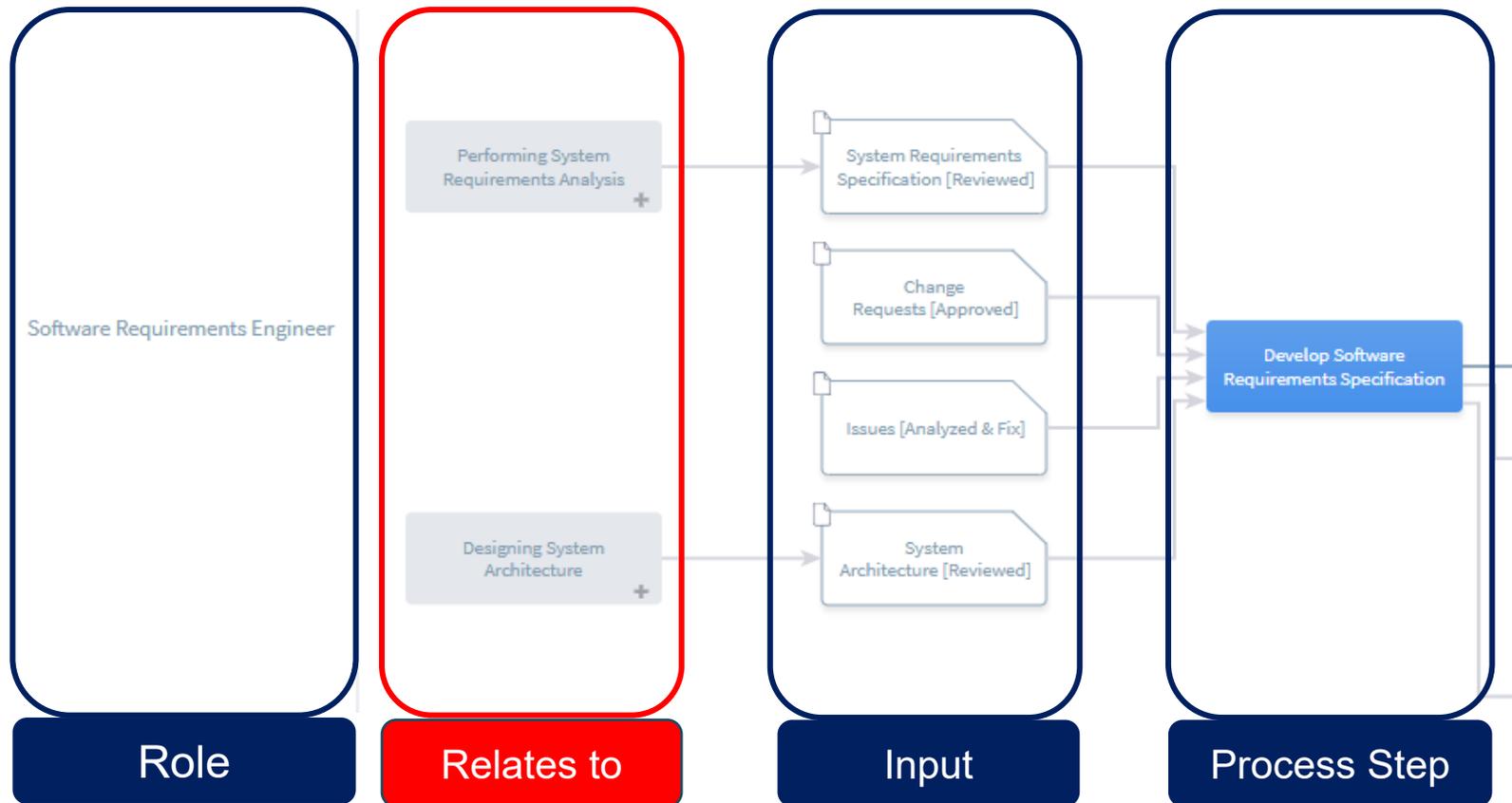


Re-use of existing information
In search for a smart solution



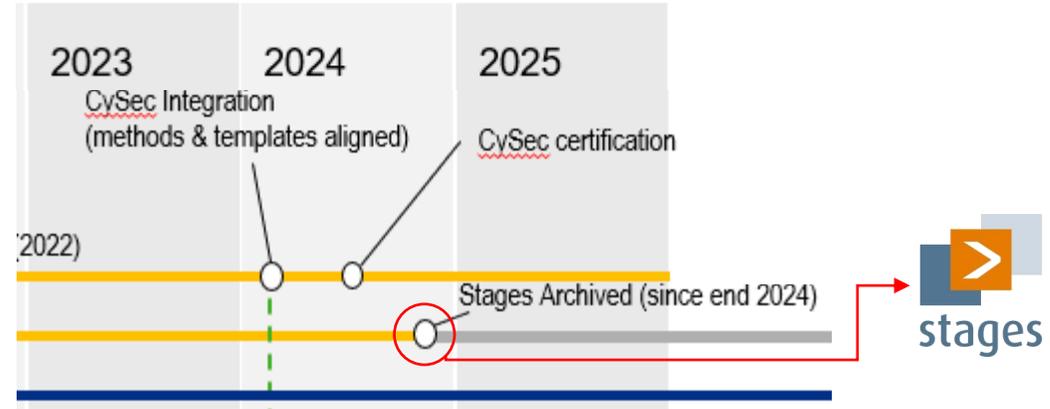
Process Relations

Ability to show Interfaces with other related processes
A strong point when modeling in Stages



Summary of Stages

Process Modeling

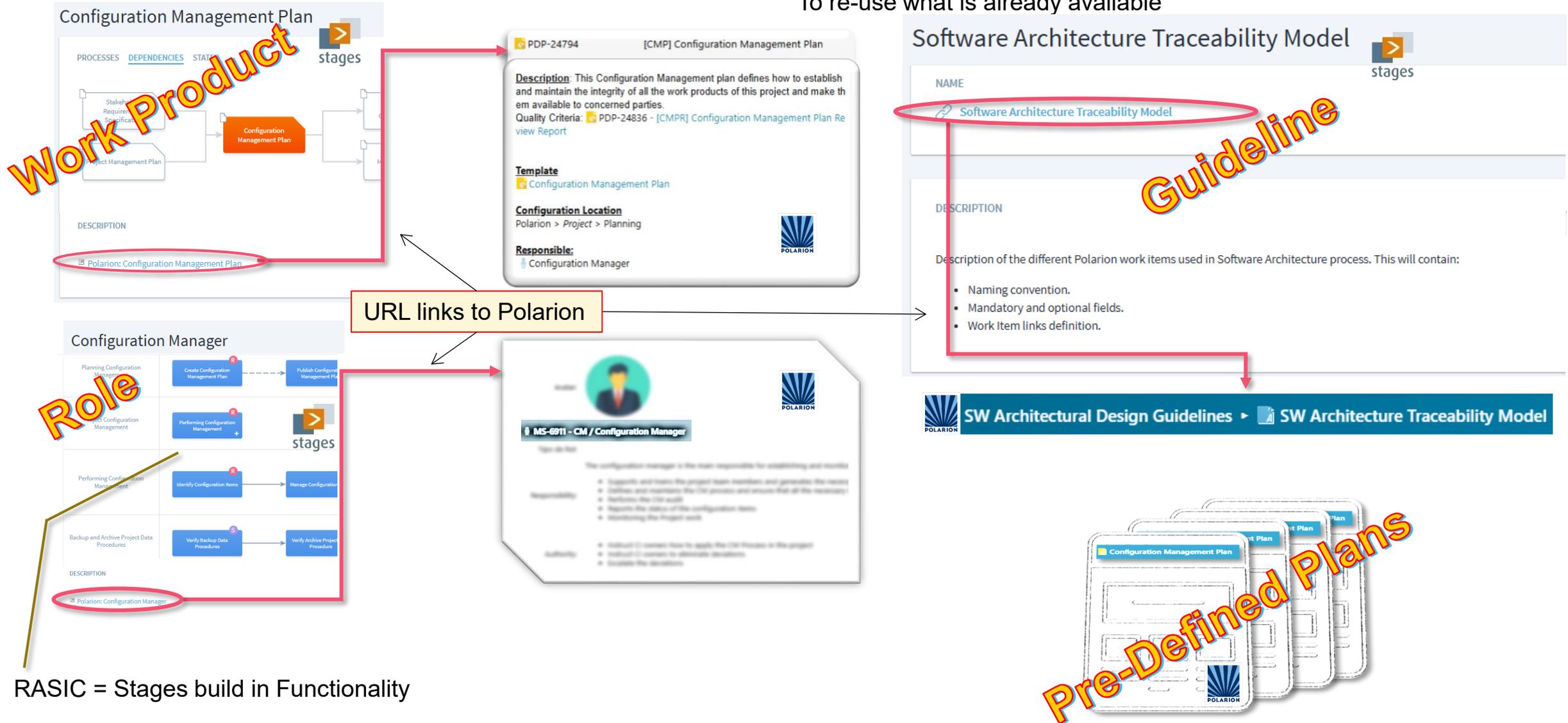


Early 2025 – Some decisions had to be taken

- ✓ Archived processes re-used where possible, otherwise edited
- ✓ All processes released for the Business Unit
- ✓ Modeling guidelines updated along the way
- ✓ Process Owners and PIM's (see next slides) trained on modeling
- ✓ URL linking (towards ALM) introduced in all Processes

Implement a smart solution

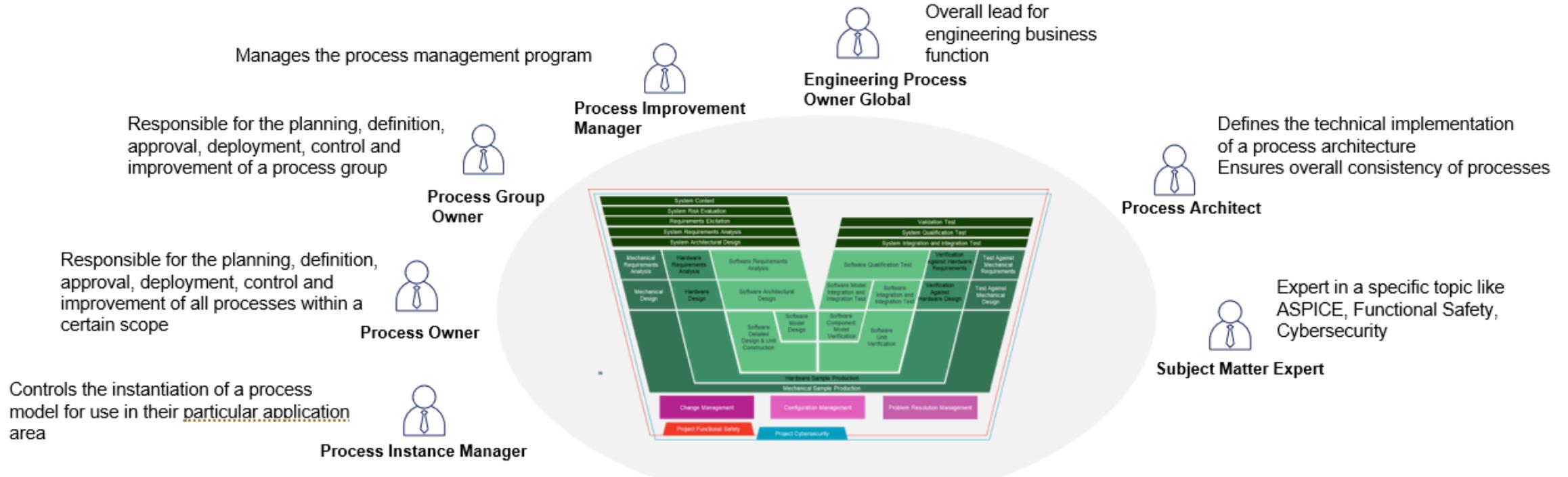
Bring Stages and Polarion together
To re-use what is already available



RASIC = Stages build in Functionality

Process Governance

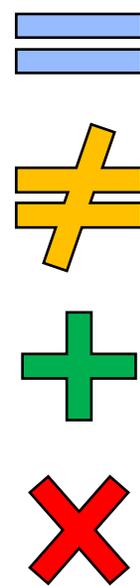
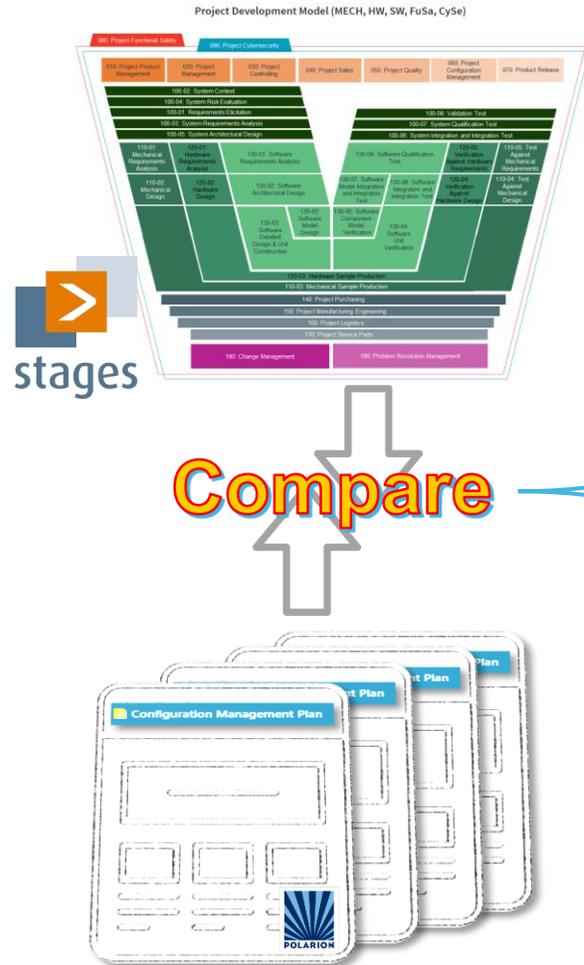
Strengthen our Process culture



Process Tailoring

From Standard to Defined process for the Project

Process and Plan are compared
Tailoring is noted per Process

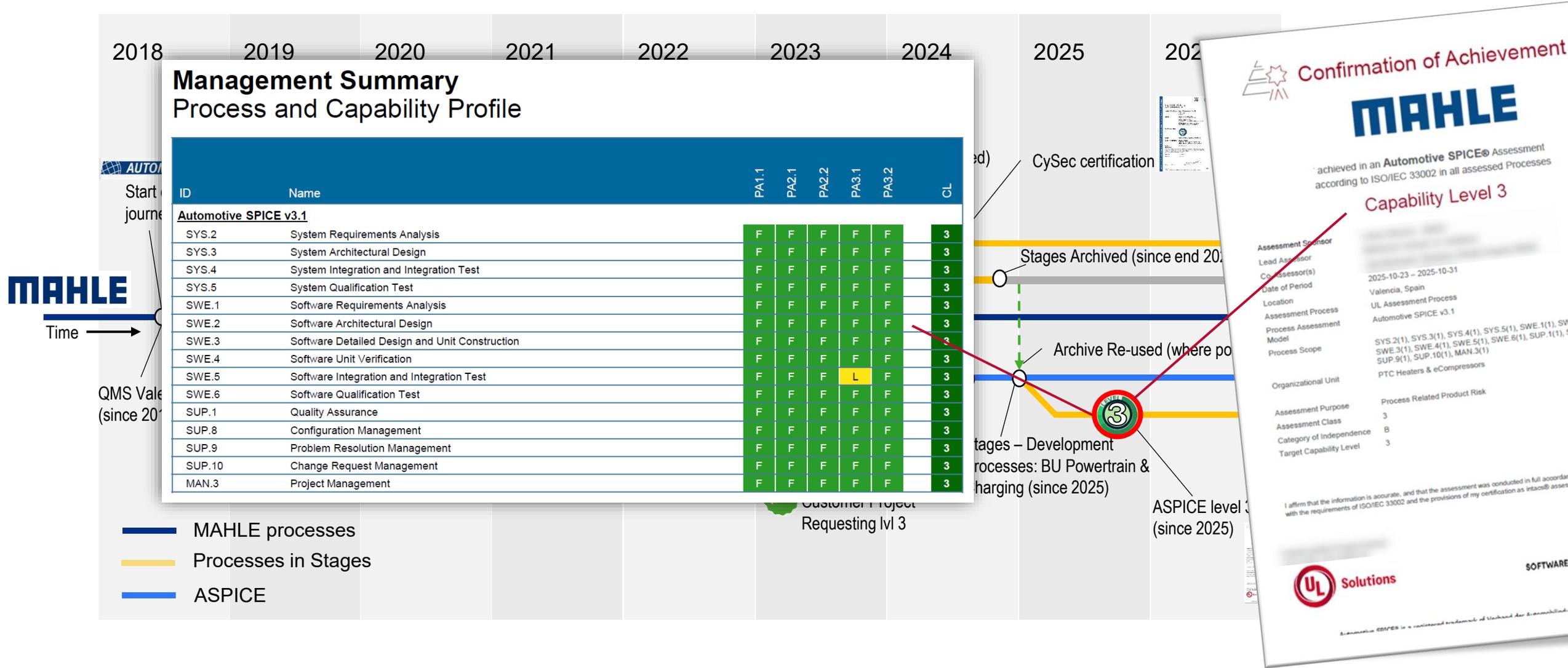


<i>Software Requirements Analysis</i>	No tailoring			Accepted
<i>Software Detailed Design and Unit Construction</i>	<u>W.P.</u> : coding guidelines and the coding checklist	The project is using the previous version with some added information	The content is equivalent to the new version	Tailored
<i>Software Unit Verification</i>	<u>W.P.</u> : unit verification checklist	The project has added additional checks	The content is improved	Tailored
<i>Software Integration Verification</i>	<u>Activities:</u> Develop Software Intra Component Test Cases Review Software Intra Component Test Cases	This has been introduced for ASPICE 4.0 projects only.	There are not component requirements	T.out

Accepted (no tailoring needed), Different (Tailored), Added (Tailored), Removed or Not Done (Tailored Out)

Moment of truth

ASPICE level 3 capability confirmed



Conclusions

- Always connect Process Improvements with 1 or more customer project(s):
 - Project time constrains usually requires for smart and efficient solutions
 - The improvement or process is really lived
 - Project team gains experience and provides feedback to improve
- Don't start from scratch, having a basis or foundation supports significantly
 - APF Modeling Framework & standard modeling guidelines
 - Archived processes and good practices
- Harmonization can be easier reached by taking teams/people to a new environment or tool
 - It will avoid the “My configuration is better than yours” discussions
 - It takes them out of their comfort zone, forces teams to understand the other perspective

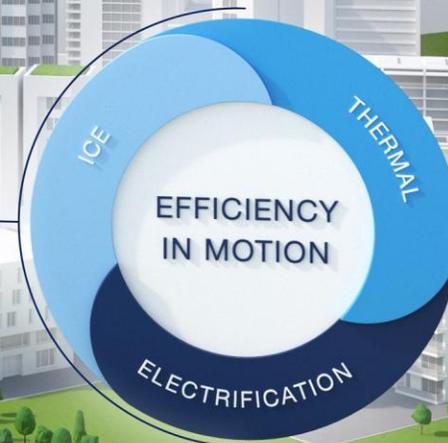
It doesn't need to be perfect; it needs to be working!

Next steps

- Increase maturity of processes modelled into Stages.
- Explore and introduce tailoring functionality of Stages.
- Create further project instances to consolidate our certificates and ensure the process continuous improvements.
- Incorporate pilot project lessons learned into the process governance.

Thank you – questions?

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MAHLE