



AMPERE

QUALITY – SOFTWARE

HOW TO APPLY SW QUALITY ASSURANCE AND ENSURE ADHERENCE WITH A-SPICE IN ITERATIVE DEVELOPMENT

2024-06-15

GENERIC INTRODUCTION



- ❑ Welcome to our **G4SPICE** training session, where we will explore the concept of **Software Gates** and **Maturity Levels** and their significance for Vehicle and Sweet Milestones
- ❑ We'll begin by a presentation of the **Ampere SW process** then an explanation of what **Software Gates** are and finally offer insights into how **Maturity Levels** can address the iterative way of working.
- ❑ The **Maturity Level** is a real-time aggregated gauge consolidating the Quality status of all SW integrated into a vehicle project.
- ❑ **Maturity levels** are measured on groupings of features (SWx baselines) corresponding to prioritized product increments.

PART 1

ASWP/O52 PRESENTATION

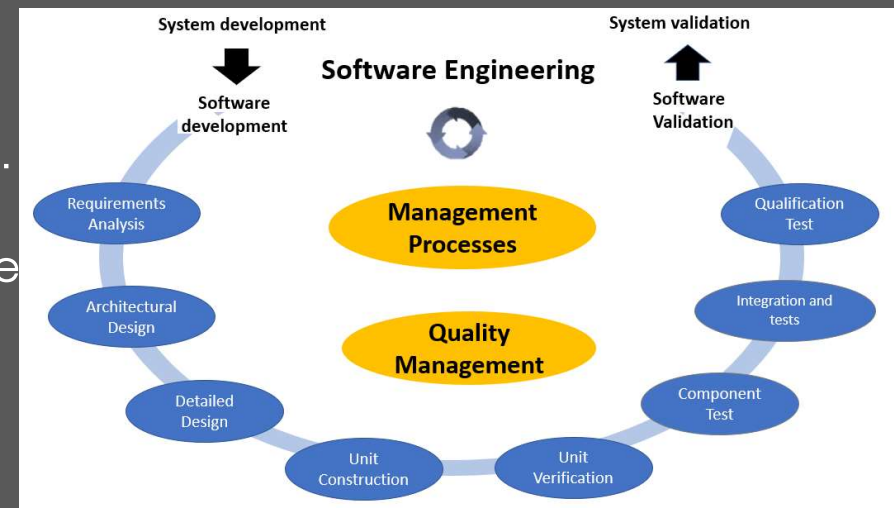
WHAT IS AMPÈRE SOFTWARE PROCESS (ASWP/O52) ?



❑ Ampère SoftWare Process is the metier processus for embedded software development, modeled in STAGES tool, validated by Ampère

❑ ASWP help to standardize the software development methodology for quality improvement and help with Tiers-1 interactions.

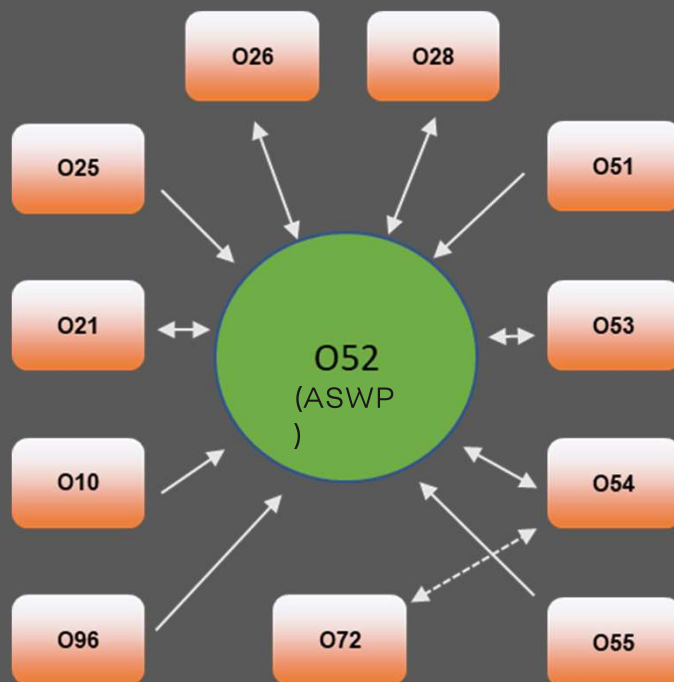
❑ We didn't request to Tiers-1 to apply our process nevertheless we will request them our standardized deliverables



SCR – SYSTEME DE CONCEPTION RENAULT



Interactions avec les autres processus fédérateurs



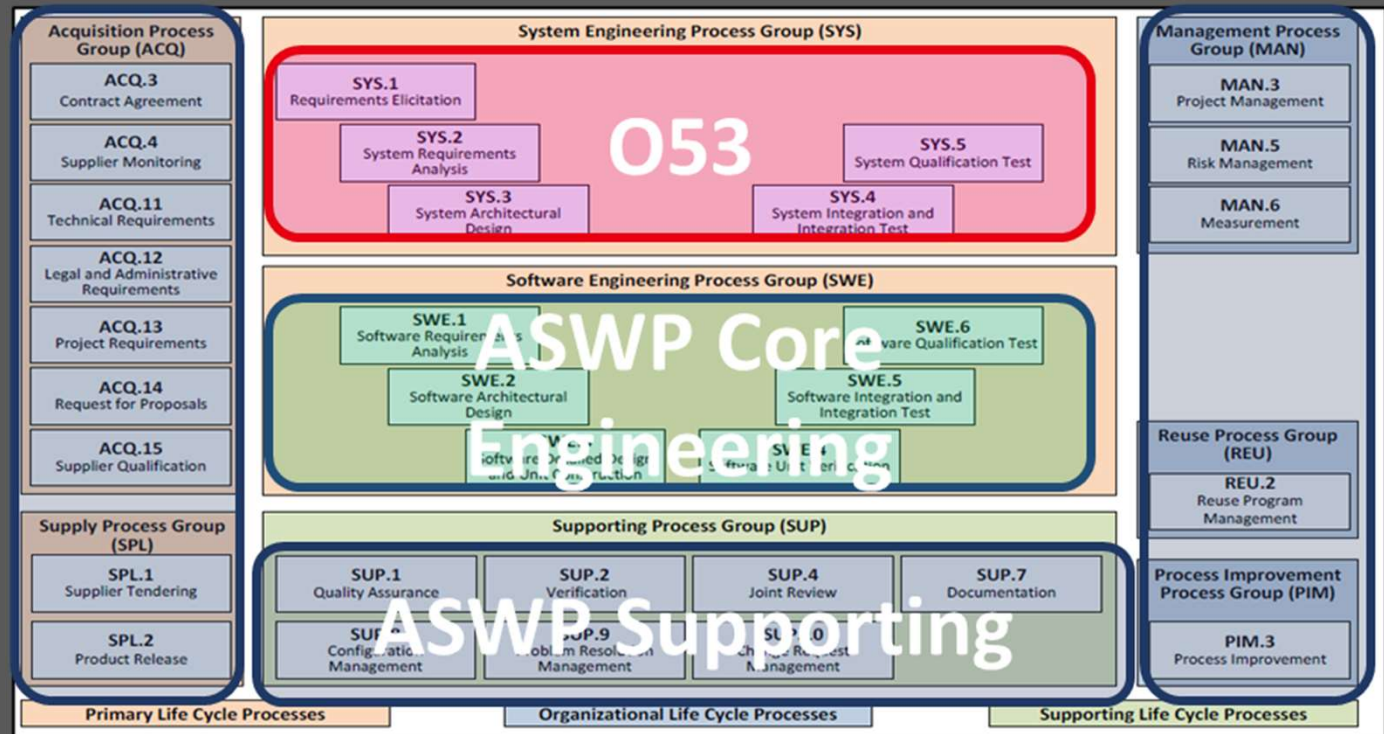
Le processus O52 est en interactions avec 10 processus

- | | |
|-------------|---|
| O10 | Piloter les projets organes en développement |
| O21 | Piloter les projets SWEET en phase de cadrage |
| O25 | Anticiper et déployer les nouvelles réglementations |
| O26 | Arbitrer et piloter les projets véhicules en développement |
| O28 | Piloter les validations |
| O51 | Assurer la convergence PxP prestation électrique électronique |
| O53 | Concevoir et valider les systèmes |
| O54 | Concevoir les pièces POE / POI |
| O55 | Assurer la convergence PxP Service du diagnostic |
| O72 (indir) | Piloter les modifications en vie série (*) |
| O96 | Piloter les projets innovations du plan stratégique [T] |

ASWP & AUTOMOTIVE SPICE CONNECTION

- ❑ ASWP is aligned with version 3.1 of A-SPICE
- ❑ "SYS" process is covered by O53
- ❑ Complete "SWE Process Group" is covered by ASWP
- ❑ The other processes are additional processes defined or instantiated for ASWP.

Mapping of ASWP and
ASPICE Process Reference
Model



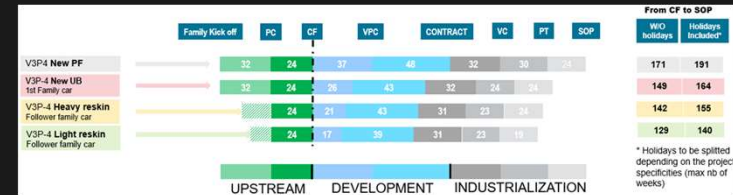
PART 2

SW GATES PRESENTATION

SW GATES INTRODUCTION

Vehicle Milestoning :

- ✓ Vehicle development process is based on milestones
- ✓ Each milestones define a level of vehicle process maturity and associated checking points
- ✓ All this informations are detailed in V3Px description



SW GATES:

- ✓ SW GATES are defined in ASWP/O52
- ✓ SW GATES represent the SW « milestones » synchronized with Vehicle one's
- ✓ As Vehicle milestones describe vehicle development cycle verification points, SW Gates describe Embedded SW development verification points
- ✓ SW GATES define the requested maturity of a SW related to a dedicated Vehicle milestone
- ✓ They are then fully synchronized with V3Px

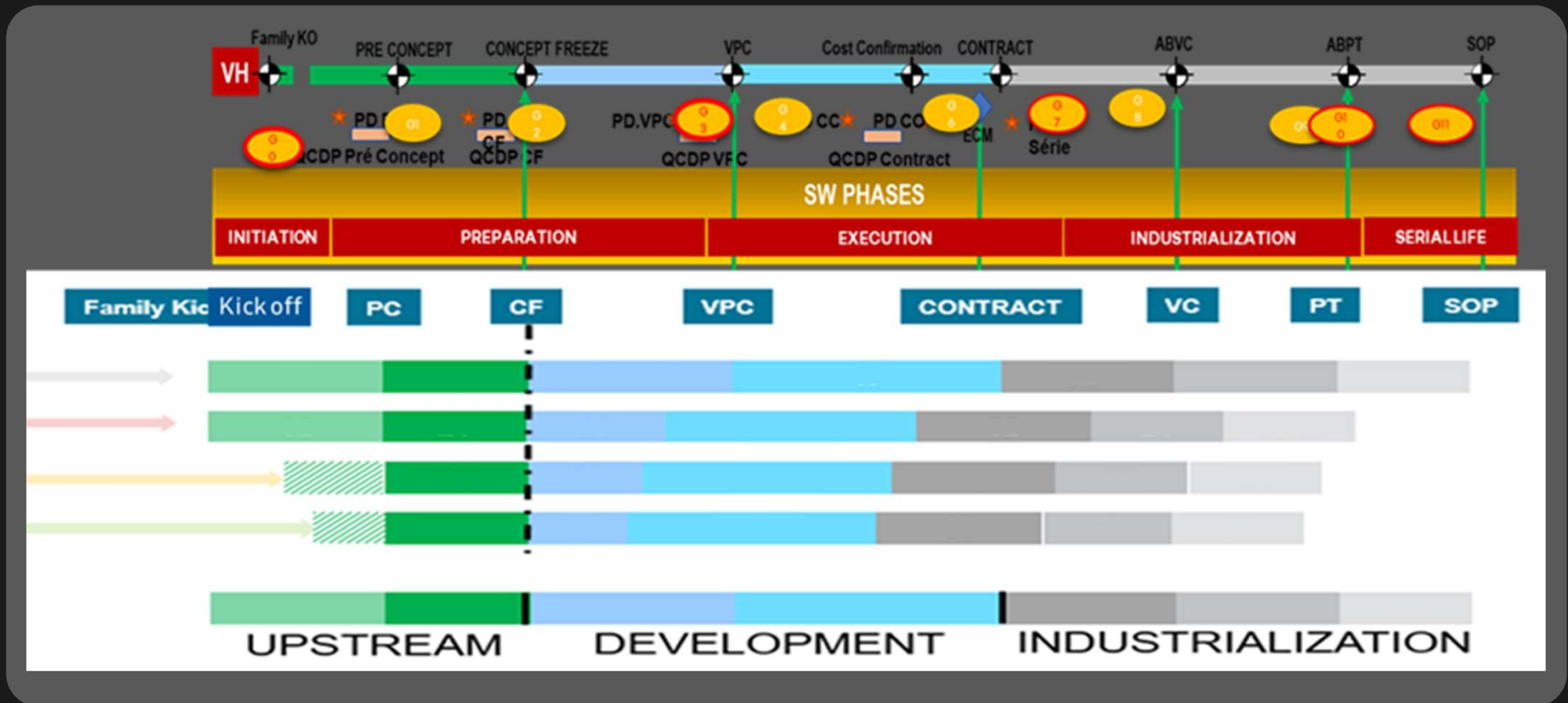
REMARKS

- ❑ SW GATES are fully defined in ASWP
- ❑ SW GATES are easy to use in a V3P approach (V cycle development)
- ❑ SW GATES must be managed differently in an iterative (AGILE) development cycle (see later SW Maturity Level)

MAPPING OF SW GATES WITH VEHICLE MILESTONES

Global overview

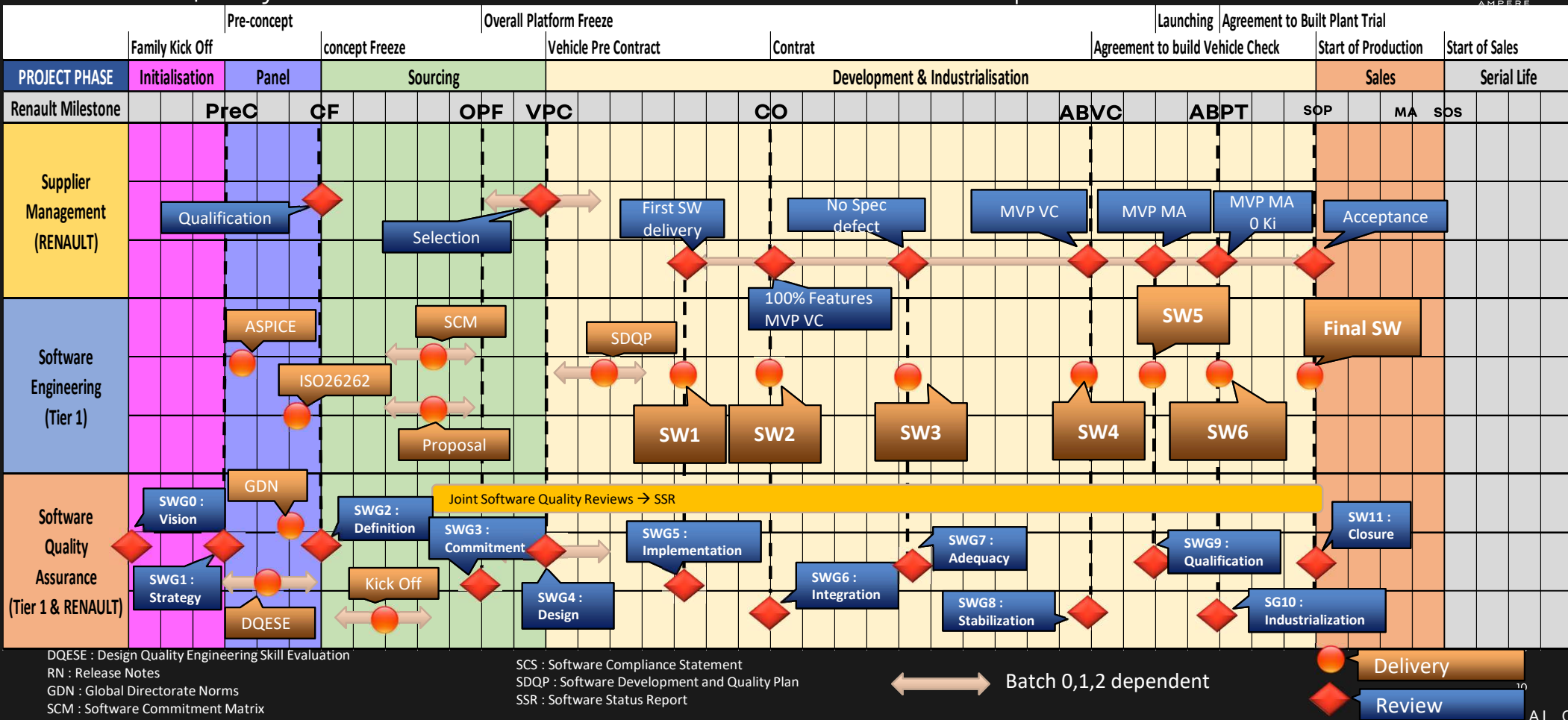
- ✓ At each vehicle milestone an associated SW GATE



SW GATES GLOBAL OVERVIEW

SW GATES Content :

- ✓ SW GATES are designed to respect the level of vehicle milestone requirements : **No more / No less**
- ✓ All SW Quality activities are then scheduled in connexion with SW GATES planification



SWGXX : GATE NAME

SWG	V3P4 New PF	SWEET	Engine	Nissan
SWG00	PreC - 18 weeks	Intention	AU-PRE	NA

Gate objectives

Initiation Phase
Main OBJECTIVES OF SW GATE

Key metrics

MAJOR METRICS TO FOLLOW PROJECT DEVELOPMENT

Key tasks

AT VEHICLE LEVEL:
MAJOR TASKS REQUESTED BY VEHICLE PLANNING

AT SW LEVEL:
MAJOR TASKS REQUESTED AT SW LEVEL TO RESPECT VEHICLE PLANNING

Major deliverables

MAJOR DELIVERABLES REQUEST TO MANAGE TAKS DELIVERY



SWG10: INDUSTRIALIZATION GATE (+16W)

SWG	V3P4 New PF	SWEET	Engine
SWG10	ABPT - 1week	/	AU-PPC

Gate objectives



Industrialization Phase (3)

- To deliver a final SW (SW6) based on MVP MA content, fully stabilized and compliant with MA expectation
- To deliver a SW version with calibration with no more Anomalies

Key metrics



On MVP MA Scope :

- % age of STR Comp covered by SRS
- % age of SRS covered by SAD
- %age of MVP MA features delivered in SW
- %age of test Coverage, test execution, test Passed at Unit, Component and Integration level
- %age of RAM/ROM/CPU Load

SWQA Quality performance Metrics :

- STRONG Coverage/Completeness/consistency
- KPI1.a : COMMITMENT / KPI1.b : PROJECT DOD

Key tasks



AT VEHICLE LEVEL:

- To ensure the SW6 delivery compatible with final PT (final MVP MA delivery)
- SW quality delivery is mandatory to ensure a PT vehicle version delivery : These SW versions can be used for certifications/homologation

AT SW LEVEL:

- To analyze and correct all SW anomalies
- To validate all requested SW calibrations
- To deliver a SW version (**SWFinal Calib/SW6**)
 - Full features compliant to validate final MVP MA delivery with no more anomalies
 - No more anomalies means that all residual anomalies must be accepted in the acceptance form
- To deliver an approved SW maintenance plan

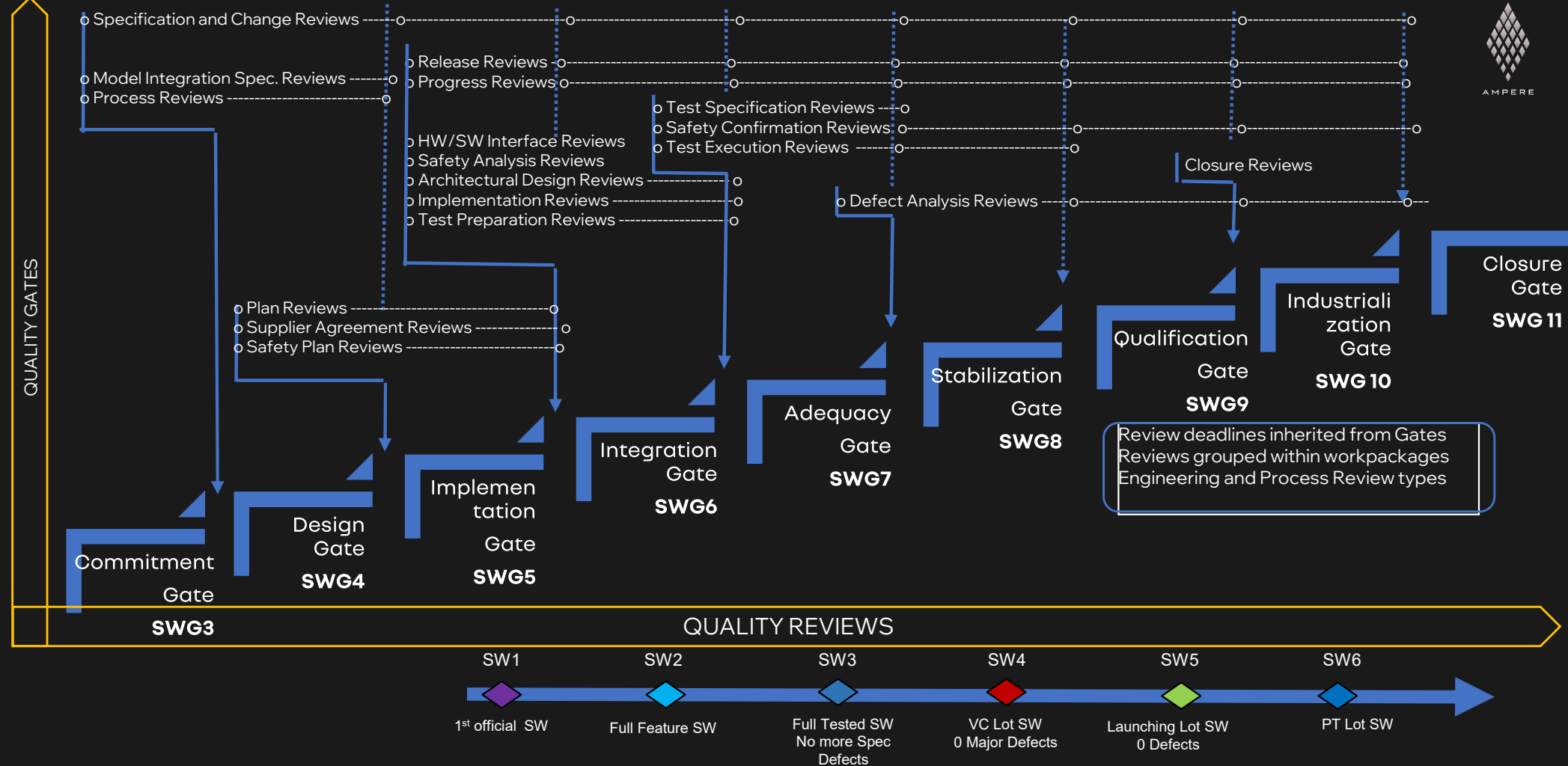
Major deliverables



- SW Maintenance Plan
- SW qualification Acceptance Form (ic Calibration)
- SWFinal Calibrated/SW6 for PT free of Anomalies



SOFTWARE QUALITY GATES AND REVIEWS





PART 3

MATURITY LEVEL EXTENSION

NON ITERATIVE DEVELOPMENT PROCESS



Key Highlights:



The V-Model software development methodology emphasizes on a **Parallel Process**, where **all features** must be completed for each phase before moving on to the next. Those phases are derived from the **Vehicle Milestones**.



It means that before progressing from one phase to the next (such as from design to coding or from testing to deployment), there is a formal review called **Software Gate** in which the **Full SWEET Software** is thoroughly examined and validated against requirements called **STRONG Tickets** derived from ASWP.



During a Software Gate, the **Status of the Software** is made before deciding to advance to the next step in the development process.



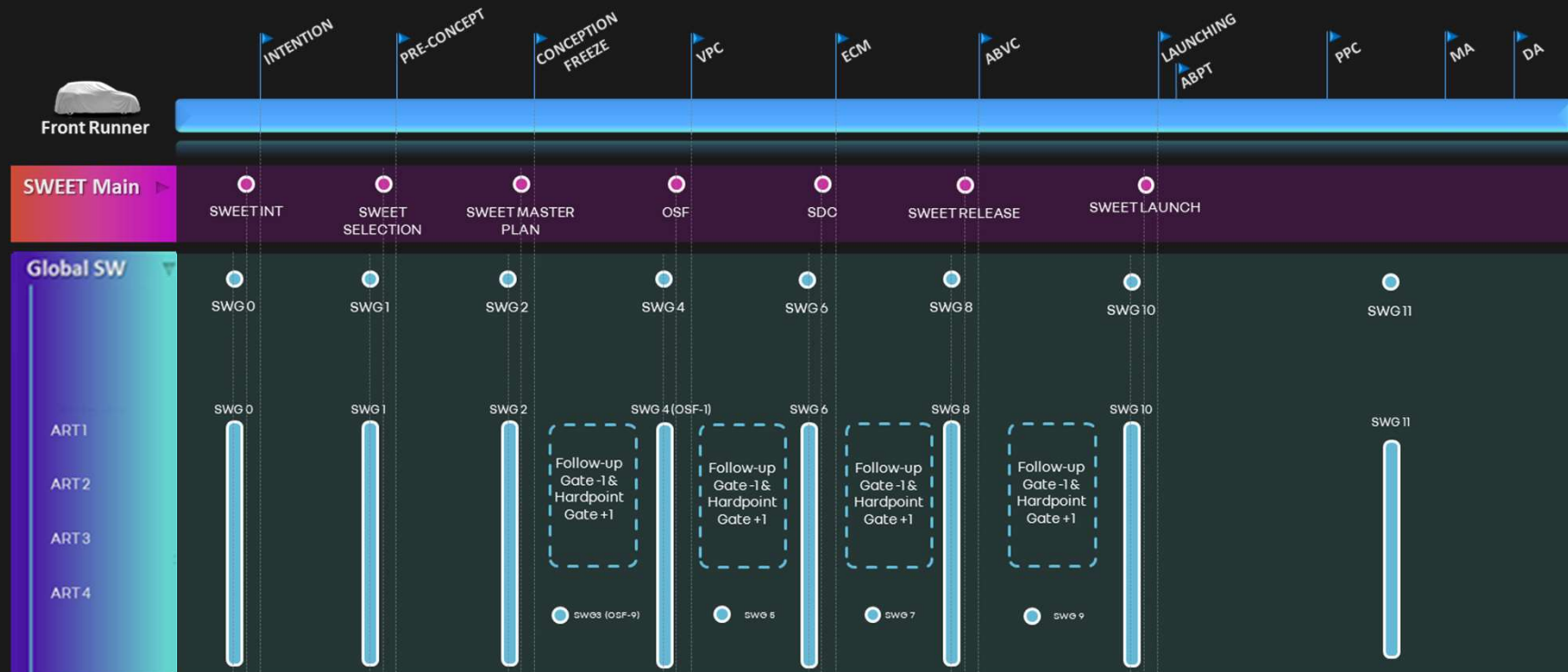
Key takeaway

- V-Cycle process
- SW Status only at a SWGate
- Partial view of the project
- Difficult feature prioritization

SOFTWARE GATES MILESTONING PROCESS



- The Software Gates are used to **monitor software development** and **validation cycle**. They establish key software milestones that align with the milestones of the vehicle.
- This guarantees that Software attains the **required maturity** level before advancing to validate the gates at SWEET Domain and Vehicle levels.



ITERATIVE DEVELOPMENT PROCESS



Key Highlights:



The Agile software development methodology emphasizes on an **Iterative** and **Incremental** development in which each feature is **Prioritized** within a **SW Baselines**



Software Teams work on their iterations, integrating and delivering value incrementally during a timeframe called **Program Increment (PI)**.



KPI, Software Maturity and Continuous Improvement are **Monitored in Real Time** during each PI to provide an up-to-date status of the SW Package



Before the end of each PI, a snapshot of required evidences status is done to define the level of risks and actions plans necessary to reach the expected level of **SW Maturity**. The associated SW Quality status is then delivered in compliance with the identified level of risk

DEFINITION OF MATURITY LEVELS



- AMPERE decides to deploy Maturity levels which is an approach common to some domains
- The Maturity Level is a **real-time** aggregated **gauge** consolidating the Quality status of **all SW** integrated into a SWEET platform
- The Maturity Level
- Maturity levels are measured on groupings of features (SWx baselines) corresponding to **prioritized product increments**.

Details on Maturity Levels

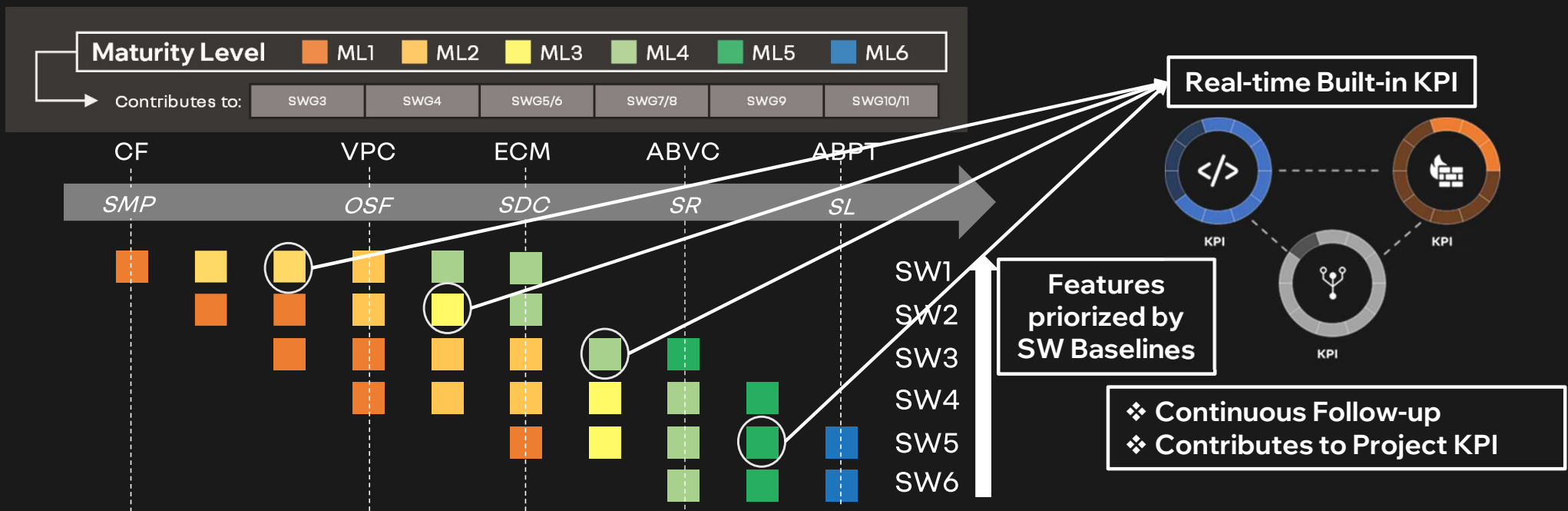
	ML1	ML2	ML3	ML4	ML5	ML6
Project Phase	Architecture, implementation and validation planning	Architecture validation	Pre-testing/buildup of expertise	Confirming customer value of functional concept	Confirmation of suitability for product launch	Maturity for series production
Functional Maturity	Features agreed upon and assigned in function list.	Requirements related to features are specified completely , agreed upon and partially implemented.	Core features implemented with limited availability and with special measures if necessary	Core features implemented in accordance with previous agreement, unlimited and stable availability in integrated system, safe emergency operation guaranteed in all variants	Functions fully implemented , unlimited and stable availability in integrated system in all variants, safe emergency operation guaranteed.	Functions fully implemented, customer-ready availability in integrated system in all variants, series parametrization for all variants .

The Maturity Levels are already being used by **leaders in the automotive industry** to guarantee optimal software quality.

BENEFITS FOR AGILE PROJECT

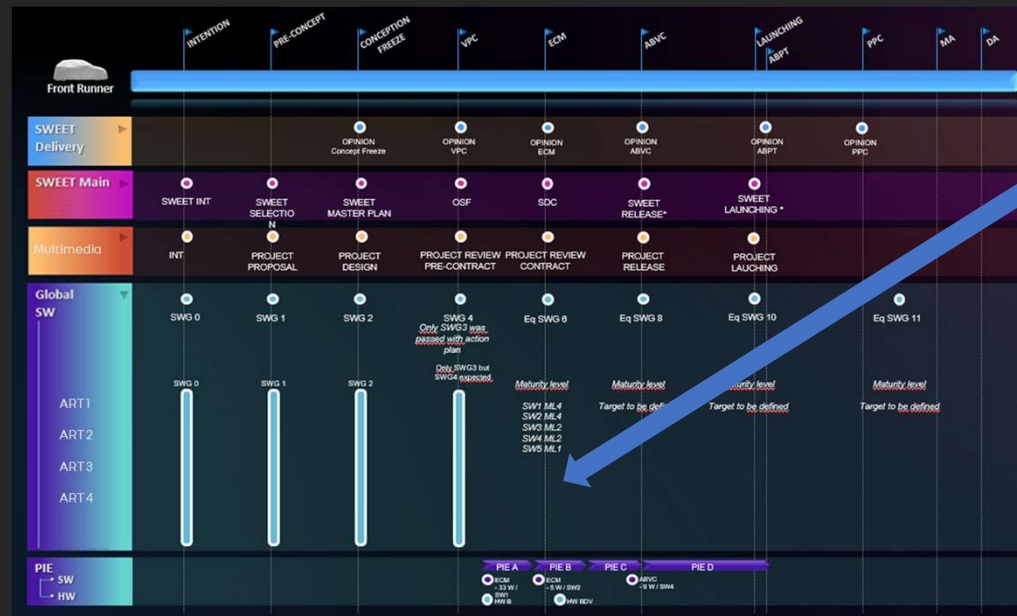
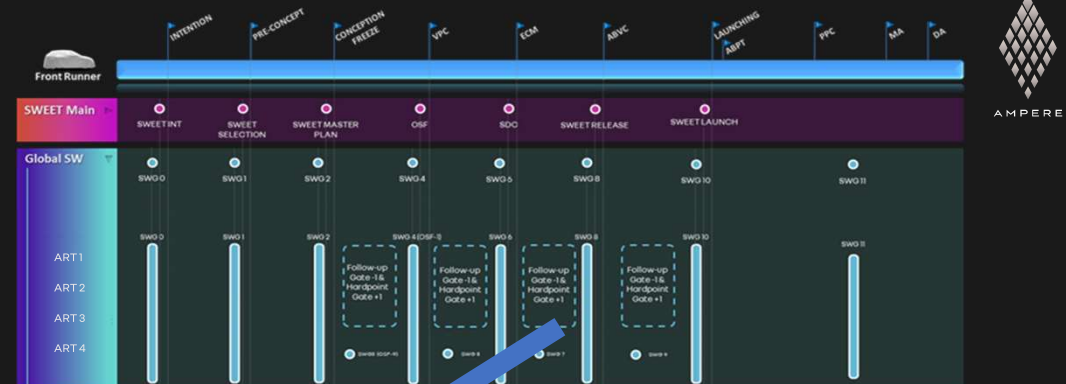


- Unified monitoring of all components and software interfaces integrated into a SWEET platform.
- Tracking by feature batches (SWx baseline).
- Accelerated feedback and anticipation of quality issues (missing deliverables, unaddressed acceptance criteria, Risk & Issue Management).
- Smoothing of SWG preparation throughout the project



ITERATIVE DEVELOPMENT PROCESS

- We move from a generic Software GATES approach to an Adapted SW Status organized by Software Gates on Maturity Level



- Between each milestone, an intermediate status is available for each domain on all SW development activities (White, Black Boxes and Offboard)
- At each Milestone a **specific deliverables target** is defined for each domain to comply with Domain planning and objectives

MATURITY LEVEL DASHBOARD & REPORTING

Quality members in each solution and train are major players in the implementation of Maturity Levels and facilitate the progress in the following manner:

- A quality engineer supports solutions in monitoring and updating quality deliverables in real-time
- Internal and supplier quality engineers support their trains in the implementation of Maturity Level deliverables for each SW Baseline
- All quality members lead by themselves Maturity Levels for specific deliverables & Acceptance Criteria
- The progress of maturity levels is followed by Quality and SDV Project via weekly statuses



Example of Maturity Levels Dashboard for a Train

HMI SW1/SW2 deliverables status					
		DONE	IN PROGRESS	NOT DONE	Total
	ML1	-	-	4 (100%)	4 (100%)
	ML2	-	-	4 (100%)	4 (100%)
	ML3	-	-	7 (100%)	7 (100%)
	ML4	-	-	2 (100%)	2 (100%)

CONCLUSIONS

SW GATES:

- ✓ SW GATES represent the SW « milestones » synchronized with Vehicle one's
- ✓ As Vehicle milestones describe vehicle development cycle verification points, SW Gates describe Embedded SW development verification points
- ✓ They are then fully synchronized with V3Px
- ✓ All SW GATES activities and deliverables are fully described in ASWP



Maturity Level:

- ✓ Maturity Level define an expected level of SW maturity for each SW or « SW Baseline » for a dedicated milestone
- ✓ Maturity Level Quality follow up is measured thru a list of deliverables status compliancy
- ✓ Maturity Level give the opportunity for each SW or « SW baseline » to define a specific rythm of SW development
- ✓ Maturity Level are used to manage SW quality acceptance criteria in accordance with each SW development planning



WAY of Working

- ❑ For each PI, each SW or SW Baseline define an expected maturity level associated to the feature prioritization
- ❑ SW Quality activity is then adapted to the expected SW Maturity Level
- ❑ SW Quality conformity is still measure at each vehicle milestone but is focus on an adaptative list of deliverables compliant with Project development strategy and SW Quality team recommandations



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