IATF 2019
SW QUALITY ASSURANCE

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Franck SERRATRICE
Embedded Software Safety and Quality Assurance Expert
SW in Automotive

- Introduction – ALLIANCE RENAULT/NISSAN/MITSUBISHI

- Section 1 – SW IN AUTOMOTIVE – What does it mean
  - Complexity
  - Customer Satisfaction and Safety
  - Regulation

- Section 2 – SW IN AUTOMOTIVE – Actions Plan in ALLIANCE
  - SW Development Standard
  - ALLIANCE SW Process
  - ALLIANCE SW Center
  - SW Quality Assurance activities

- Section 3 – SW IN AUTOMOTIVE - Conclusions

Presentation Duration : 30 mn
SW In AUTOMOTIVE

Introduction – ALLIANCE RENAULT/NISSAN/MITSUBISHI
RENAULT NISSAN MITSUBISHI

19-YEARS ALLIANCE

10 BRANDS / 3 COMPANIES / 200 MARKETS

10.7+ MILLION PASSENGER CARS & LIGHT COMMERCIAL VEHICLES SOLD IN 2018

450,000+ EMPLOYEES WORLDWIDE

10,76 M cars sold in 2018
1 in 9 vehicles sold worldwide
775,000+ Electric Vehicles sold
450,000+ employees worldwide
122 manufacturing plants

2018 Sales Results (in million units)
OUR VISION

MOBILITY FOR ALL
Building clean, affordable and safe cars for everyone

Electrification  Connectivity  Autonomous drive

ZERO EMISSION VEHICLES

Global Leader in Electric vehicles

Nissan LEAF
Best-selling EV in the world with more than 409,000+ vehicles sold since its launch in December 2010.

Renault ZOE
is the #1 EV in Europe in 2017. Renault has sold 225,000+ EV worldwide since 2012.

775,000+
Electric Vehicles sold
SW In AUTOMOTIVE
What does it mean?
SW IN AUTOMOTIVE: Where is the REAL COMPLEXITY?

SW more and more Complex

A SIMPLE EXAMPLE

No software to manage the light!
SW IN AUTOMOTIVE: Where is the REAL COMPLEXITY?

SW more and more Complex

A SIMPLE EXAMPLE

2010 Megane Lighting “architecture”

- No direct link between Combi-switch and light
- 3 ECU involved: BCM, USM, Cluster
- Data exchange through vehicle CAN bus
SW IN AUTOMOTIVE: Where is the REAL COMPLEXITY?

SW more and more Complex

A SIMPLE EXAMPLE

In 2010 exterior lighting:
examples of functions realized by Software

• ENGINE OFF => LIGHT OFF
• AUTO LIGHTING ACTIVATION
• REMOTE LIGHTING
• COMODO PROBLEM => LIGHTS ON
• ...

• BCM MEGANE 2010 : SW size = 650 kB (including 90 kB basic SW)
• LIGHTING FUNCTION : SW size = 7.4 kB

In 2019 exterior lighting complexity increase
examples of functions realized by Software

• NEW DASHBOARD FUNCTION
• NEW MULTIMEDIA SYSTEM
• NEW CAMERA IDENTIFICATION FUNCTIONS ...
**SW IN AUTOMOTIVE:** A KEY POINT FOR CUSTOMER SATISFACTION AND SAFETY

SW more and more **Complex**

Complex functions with major SW added value contribution (AD/ADAS, IVI…)

➢ SW development cost = around 40% vehicle cost

**Rules / Régulation Major constraints**

Safety

ISO 26262

**Safety Impacts** of SW bugs (vehicle drivers, passengers, pedestrians, other vehicles…) véhicules…

State of the art in Automotive for **SW Development Process**
Software context

Automotive Software continuously growing in size, complexity and value ➔ Strategic asset for OEM

Software stakes

- Time to Market acceleration
- Cost of development reduction
- Quality & Robustness improvement
- Reinforcement of Software skills

Software development

- Open source
- Industry standard protocols (Autosar, Android …)
- Common Alliance platforms

Willingness to take back the lead in Software development
# SW in Automotive: Stakes for the Alliance

<table>
<thead>
<tr>
<th>Stakes</th>
<th>Lever</th>
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<tbody>
<tr>
<td>1 Reduce SW development cost</td>
<td>SW development and components costs with improvement of re-use on systems leading to increase development efficiency</td>
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<tr>
<td>2 Improve SW Robustness</td>
<td>Reduction of SW quality bugs by 50%</td>
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<td>3 Become responsive to market</td>
<td>Acceleration of time to market by 2x</td>
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<td></td>
<td>• Decrease SW Warranty cost per vehicle</td>
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<td></td>
<td>• Operational deployment of FOTA</td>
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<td>• Comply with critical safety features</td>
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SW IN AUTOMOTIVE: WHAT ABOUT REGULATION CONTEXT?

➢ A New situation:
  ▪ Regulation authority became more suspicious towards car manufacturers
  ▪ Market survey will be systematic in Europe from 2020
  ▪ up to 30k€ per vehicle in case of Non compliance with Regulation requests
SW In Automotive

ACTIONS PLAN in ALLIANCE

MOVING FORWARD
SW IN AUTOMOTIVE: ALLIANCE RENAULT NISSAN DESIGN SPECIFICATIONS (RNDS)

Automotive Standards

- SW Architecture Standards
- ASpice
- Safety - ISO 26262
- MISRA rules

RNDS

ALLIANCE RETEX

SUCCESSFUL SW DEV

SW DEP PROCESS

SW ORGANIZATION

SW QUALITY ACTIVITIES

Confidential C
SW IN AUTOMOTIVE: ALLIANCE SOFTWARE DEVELOPMENT PROCESS

ASWP

Ensure Final Customer Satisfaction

Improve SW Development Efficiency

Ensure Compliance with Automotive Standards and Regulations
**SW highlights:**

- A complex SW is never free of bugs
- A SW bug is present from the design of the SW

**PROCESS ROBUSTNESS IS THE KEY OF SW QUALITY**
SW IN AUTOMOTIVE : ALLIANCE SOFTWARE CENTER ORGANIZATION

Worldwide team
>2000 FTE (Full Time Equivalent)
Workforce & Specific skills
Regional focus
Job sharing
High Value activities in Japan and France
Execution in India
Renault SW Labs

Internal FTE in France and Japan
Strong Workforce in India
Additionnal SW centers
Offshore / Vendor / Contract (worldwide)
**SW IN AUTOMOTIVE: SUPPLIER SW QUALITY ACTIVITIES**

**Automotive Standards**
- RN SW QA Standard
- SW Architecture Standards
- ASpice
- Safety - ISO 26262, 29119
- MISRA rules

**Supplier**
- Supplier Aspice/CMMi Certificate
- SW Development Process
- Reusable SW Assets

**DQSESE (SW suppliers audits)**

**Supplier Capability**
(Confidence Level of SCM and SCS)
Strenghts & Improvement points
NEW CLIO CONTRACT ECUs LIST => 52 ECUs

DIVERSITY:
- Up to 70 ECUs / vehicle
- 1000s configuration / vehicle
- Around 20 vehicle projects concurrently

Full vehicle Suppliers SWQA monitoring

<table>
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<tr>
<th>KPI</th>
<th>Coverage</th>
<th>Target = 100% Measure = 100% 5012 ECUs with a decided strategy</th>
<th>Completeness</th>
<th>Target = 100% Measure = 98% 100% of outcomes evaluated</th>
<th>Consistency</th>
<th>Target = 80% Measure = 96% 100% or outcomes green or orange</th>
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SOFTWARE QUALITY ASSURANCE PROCESS

SW IN AUTOMOTIVE: SUPPLIER / INTERNAL
SW QUALITY ACTIVITIES

Audit
Lessons Learned

Gate Reviews

SWQA Status

Supplier / internal commitment
Supplier / internal strategy Selection

Supplier / internal Follow up

Release Notes

Joint Reviews

SUCCESSFUL SW DEV
SW DEV STANDARD
SW DEV PROCESS
SW ORGANIZATION
SW QUALITY ACTIVITIES
SW in AUTOMOTIVE

CONCLUSIONS
SW IN AUTOMOTIVE: CONCLUSIONS

SW AUTOMOTIVE MARKET
- SW Complexity
- Automotive Regulation
- Automotive SW cost

CONSTRANTS

SW QUALITY IMPROVEMENTS
- SW Process Robustness
- SWQA Activities
- Tools/Measures deployment

SWQA CRITERIA

STRATEGY
- ALLIANCE SW Process
- ALLIANCE SW Center
- SWQA Activities

SW ROBUSTNESS