Valeo

SMART TECHNOLOGY
FOR SMARTER MOBILITY

August 5th 2020

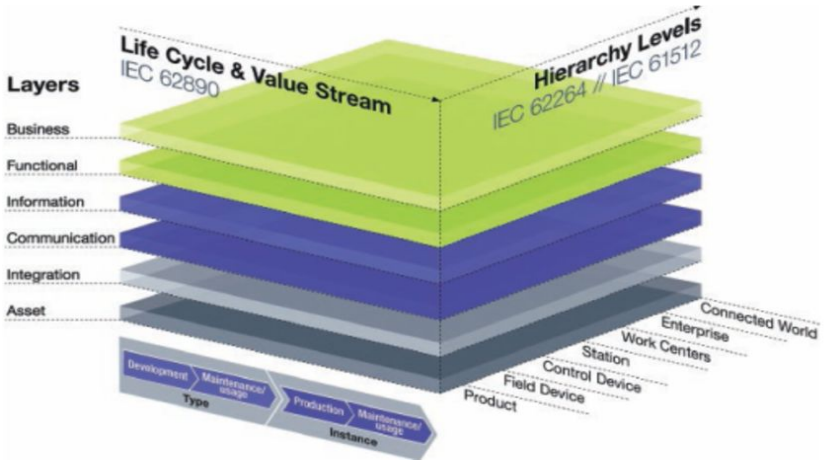
Evolution of Automotive Safety Using a Digital Twin

EXECUTIVE CONNECT 2020

Introduction

Future of mobility

CASE - *Connected / Automated / Shared / Electric*

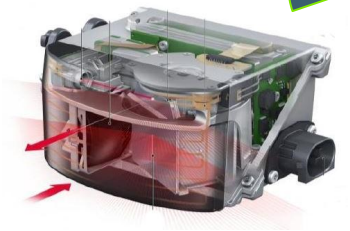


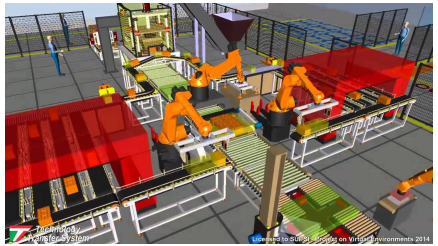
Main area of digitalization for Automotive :

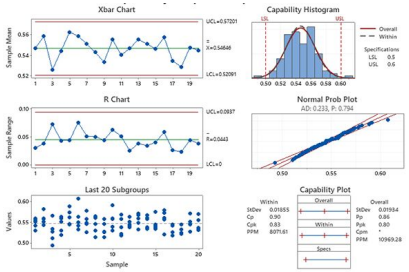
- Transformation from functionality to service
- Multi-modality and autonomous vehicles
- Disruption of automotive industry supply chain
- Businesses integrate IoT, big data analytics and security
- Country-specific, digital retailing strategy for cars, aftermarket and servicing

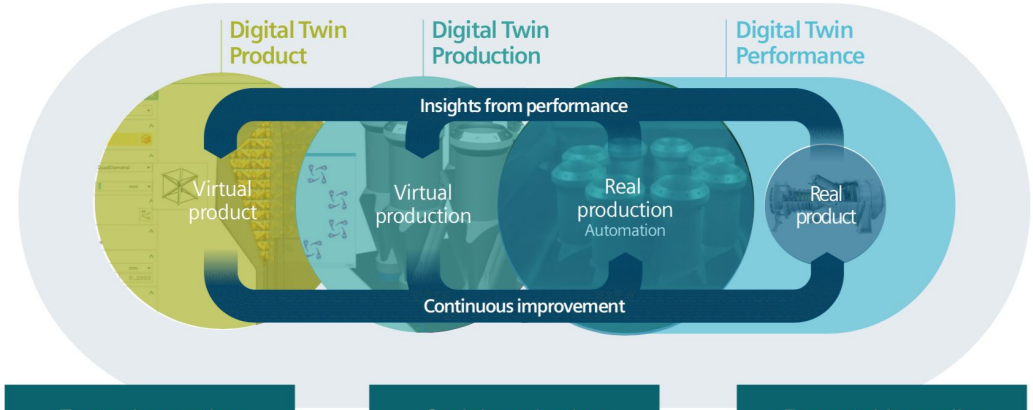
OEM and Tier 1 transformation from mechanical manufacturing to Innovation & solution provider ?

ADAS digital twin - global view









Faster innovation

Serial production

Repeatable quality

ADAS digital twin

Develop faster - technology simulation & limits, conditions simulation

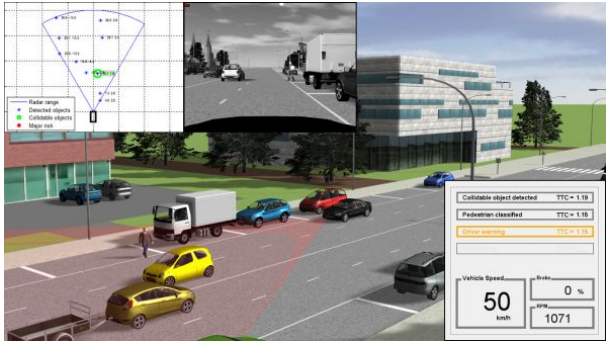
Integrate faster - digital interactions with other sensor / system models

Modify / customize effectively - new applications, customers, legislation

Functionality on demand - detection only vs. full functionality integration

Virtual testing and validation - detection, data fusion, functions, systems

Test & validation tools - MiL, SiL, HiL, ViL overall system virtual test tools

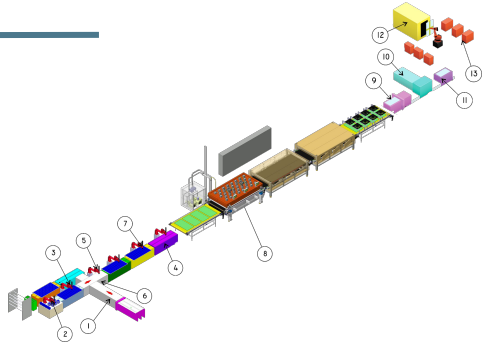


Virtual production line development - process, logistics, optimization

Virtual test development - assembly alignments, EOL

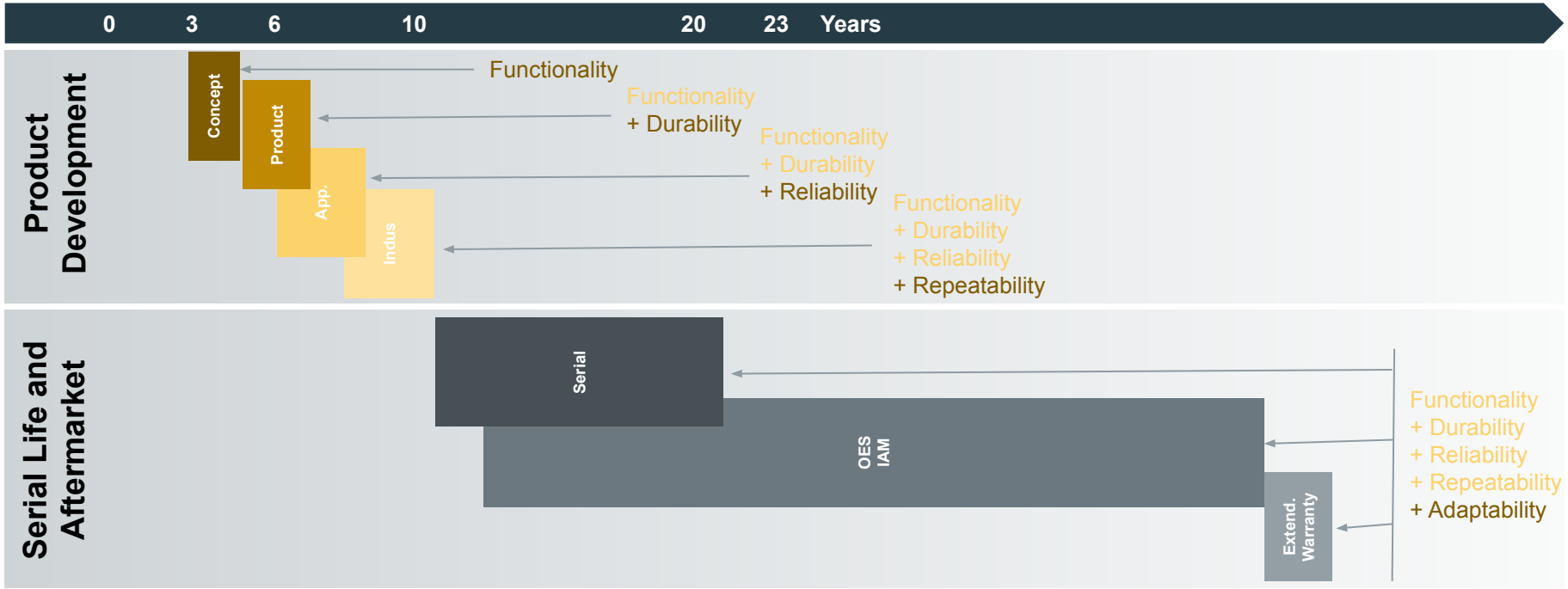
Human factor avoidance - robotization (robots, cobots)

Fast customization - product line for more products / customers



Legal and ethical aspect - is virtual test & validation enough for automated ADAS product modification?

AD/ADAS | Product Lifecycle



Automotive Industry Requires Confirming <u>Functionality, Durability, Reliability and Repeatability</u>
After <u>23 Years</u> of Start of Development
OEM/OES/Regulations Require <u>Adaptability</u> after <u>15 Years</u> of End of Development

AD/ADAS | DT vs Product/Process

Mission and evolution of the digital twin versus the product and process evolution:

- SW emulator for basic functions – Baseline DT
- SW emulator for updated functions to cover durability, reliability and repeatability (production) – Launch compatible DT
- Post-development requirements evolution on base product – Product change request versus baseline (HW&SW)
- Post-development process requirements evolution – New capacity, quality, logistic and process regulatory concept

DT and big data evolution and usage with newer SW platforms and HW IS to demonstrate compliance and validate deviations????

AD/ADAS | Vehicle Safety Rating Evolution

2009

Main focus on crash safety (front and lateral) for both car occupant and VRU)
Safety features include seatbelt reminder and speed limitation

2012

More pedestrian protection requirements than previous years.
Star rating requires much higher scores for occupant, child and pedestrian safety than previous years (5* in 2011 can go down to 4* or 3* in 2012)

2015

Significant change in rating versus previous years.
Concentration on side and front impact avoidance and mitigation (vehicle).
Higher safety standards and higher thresholds for 3,4 and 5* ratings.
Not comparable to previous years.

2018

Redefinition of the target vehicle for emergency braking with new scenarios added
Pedestrian detection (day and night), Cyclist detection (day and night)
Lane keeping functions and additional speed assistance are added
Star rating is not comparable to previous years to the amount of changes

AD/ADAS | Levels of Automation

Level 1

Provides steering, acceleration and braking support to the driver.

Level 2

Provides steering, acceleration and braking combined together support to the driver.

Level 3

Driving the vehicle automatically under limited conditions

Level 4

Driving the vehicle automatically under limited conditions. Driver, steering wheel and pedals might not be needed

Level 5

Driving the vehicle automatically under all conditions. Driver, steering wheel and pedals are not needed

AD/ADAS | Mission and Evolution of DT vs Regulations

- Car safety and automation rating evolution
- Integration of new requirements into product specification
- DT and big data usage for further development
- Correlation with real world validation

DT and big data evolution and usage with newer SW platforms and HW IS versus new requirements????

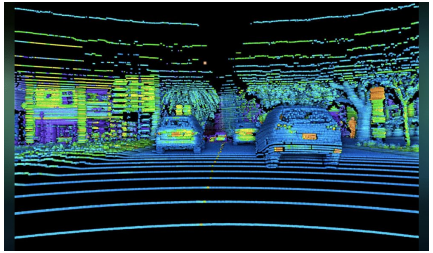
ADAS digital twin

Back-up

ADAS digital twin - product

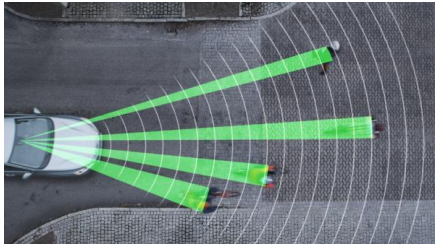
Develop faster

- Technology simulation - laser / radar / ultrasound / camera
- Tolerances, technical / technological limits, material properties
- Hard application conditions - temperature, vibrations, water, dust



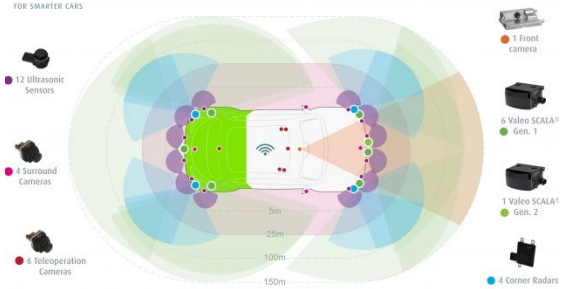
Modify / customize effectively

- New application - position, FOV, detection range ...
- New customer - different size, functionality, precision ...
- New legislation - performance, detection parameters ...



Functionality on demand

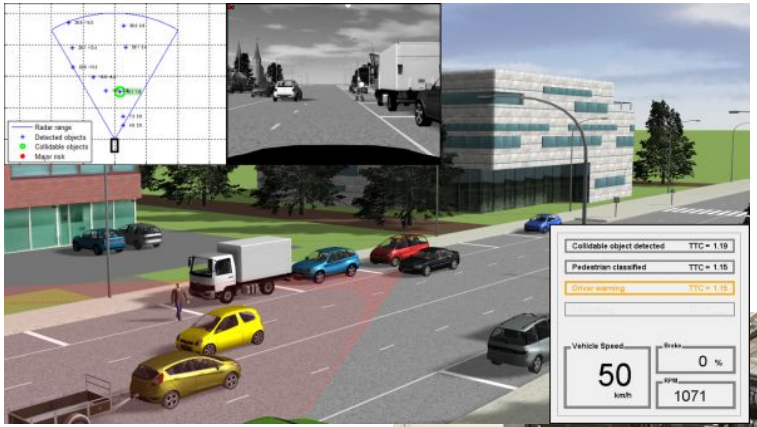
- Detection only vs. full functionality integration
- Integration into the car platform



ADAS digital twin - product

Virtual testing and validation

- Detection parameters - sensor level
- Functional parameters - sensor level
- Data fusion - system level



ADAS test & validation tools

- Software-in-the-loop
- Hardware-in-the-loop
- System-in-the-loop

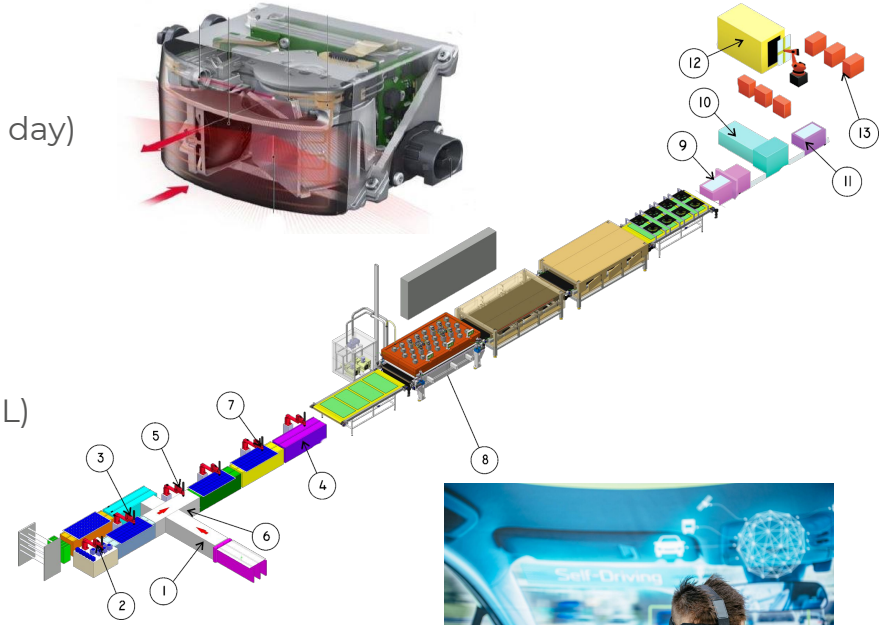
BMW case study - highway pilot

- Mean time to collision on German highways 12 500 000 km
- Robustness scenario - to be two times better
- <u>25 000 000 km to be driven and evaluated</u>
- 250 000 hours of driving / 2 500 000 hours for annotation

ADAS digital twin - production

Complex product production

- E.g. high-precise laser optics
- High-volume production (thousands of pieces a day)
- Humans lives depend on quality



Virtual production line development

- Assembly precision vs. production tact
- In-production testing (assembly alignment / EOL)
- Robotization / human factor avoidance
- Supplier quality management

Fast customization

- Utilization of production lines for multiple products / derivatives
- Customer and R&D quality feedback