

Bosch Powertrain Electrification – mobility with future



EGVIA & Capire Workshop
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Robert Bosch GmbH

Gasoline Systems

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Agenda

- Overview Electrification at Robert Bosch GmbH
- Role of Testing in the Development Process
- Typical Supplier Testing of “Components”
- Particular Challenge for Testing Electric Vehicles
- Summary & Key Messages of Supplier



Overview Electrification at Robert Bosch GmbH

Power Train for E-Bikes



Battery for Hybrids, Plug-in & EV's

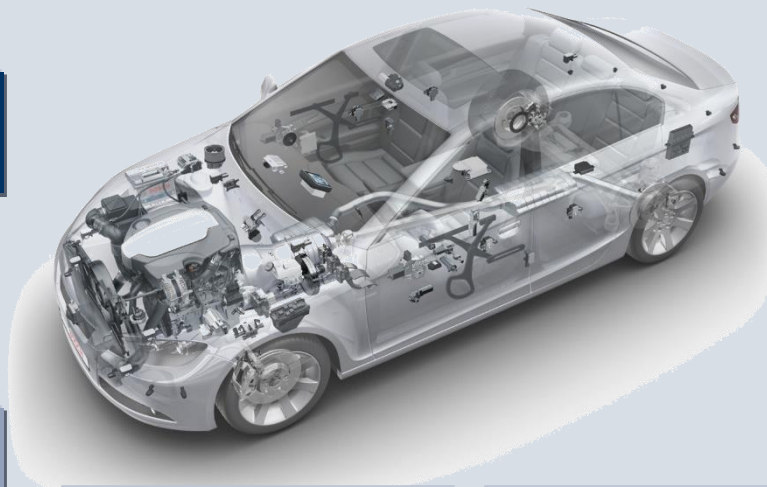


Navigation Systems



Charging Stations for Electric Vehicles

eDrive for Passenger Car Hybrids, Plug-in & EV's



Software for Infrastructure Integration



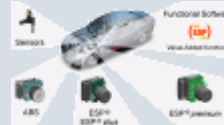
Hydraulic Hybrid Systems & eDrives for Commercial Vehicle



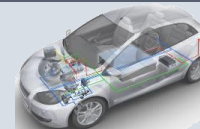
Starter and Generators for Start/Stop Systems



ABS, ESP, Brake-Booster



Research and Advanced Engineering for future Electric Vehicle Concepts



Gasoline Systems



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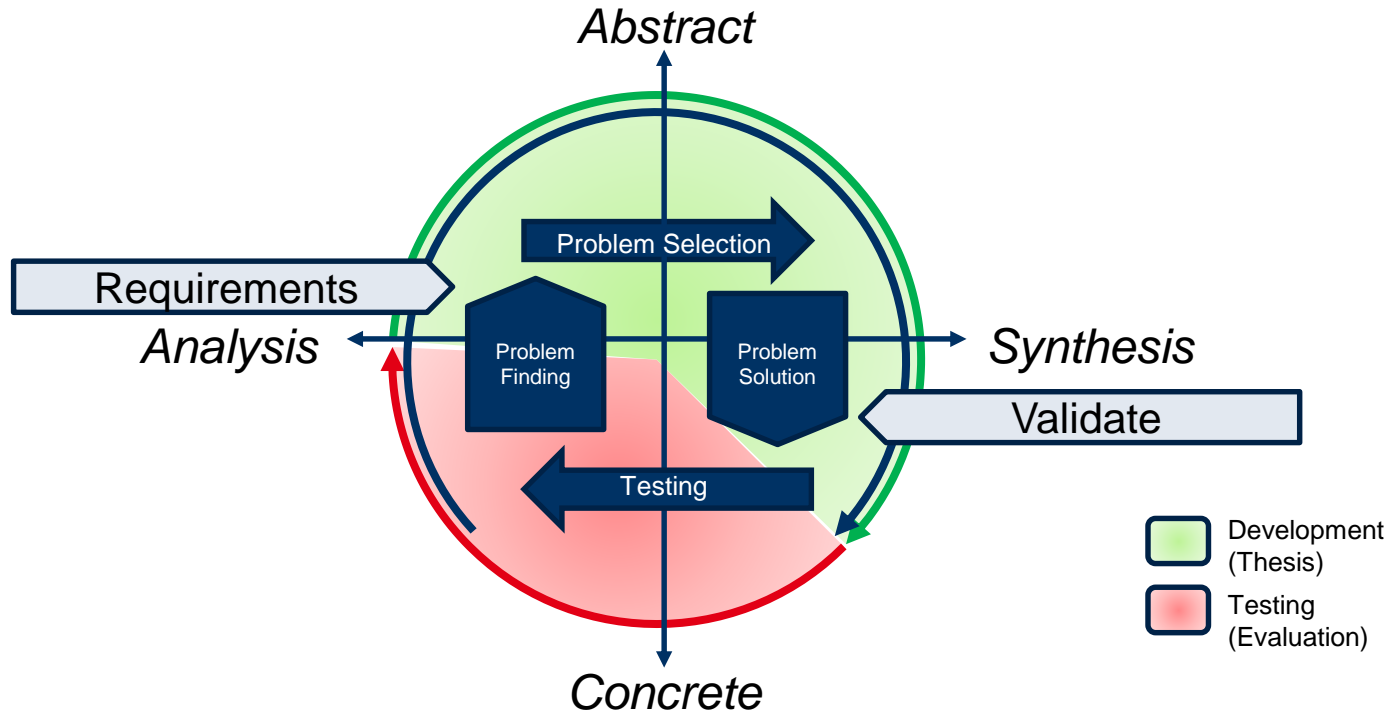
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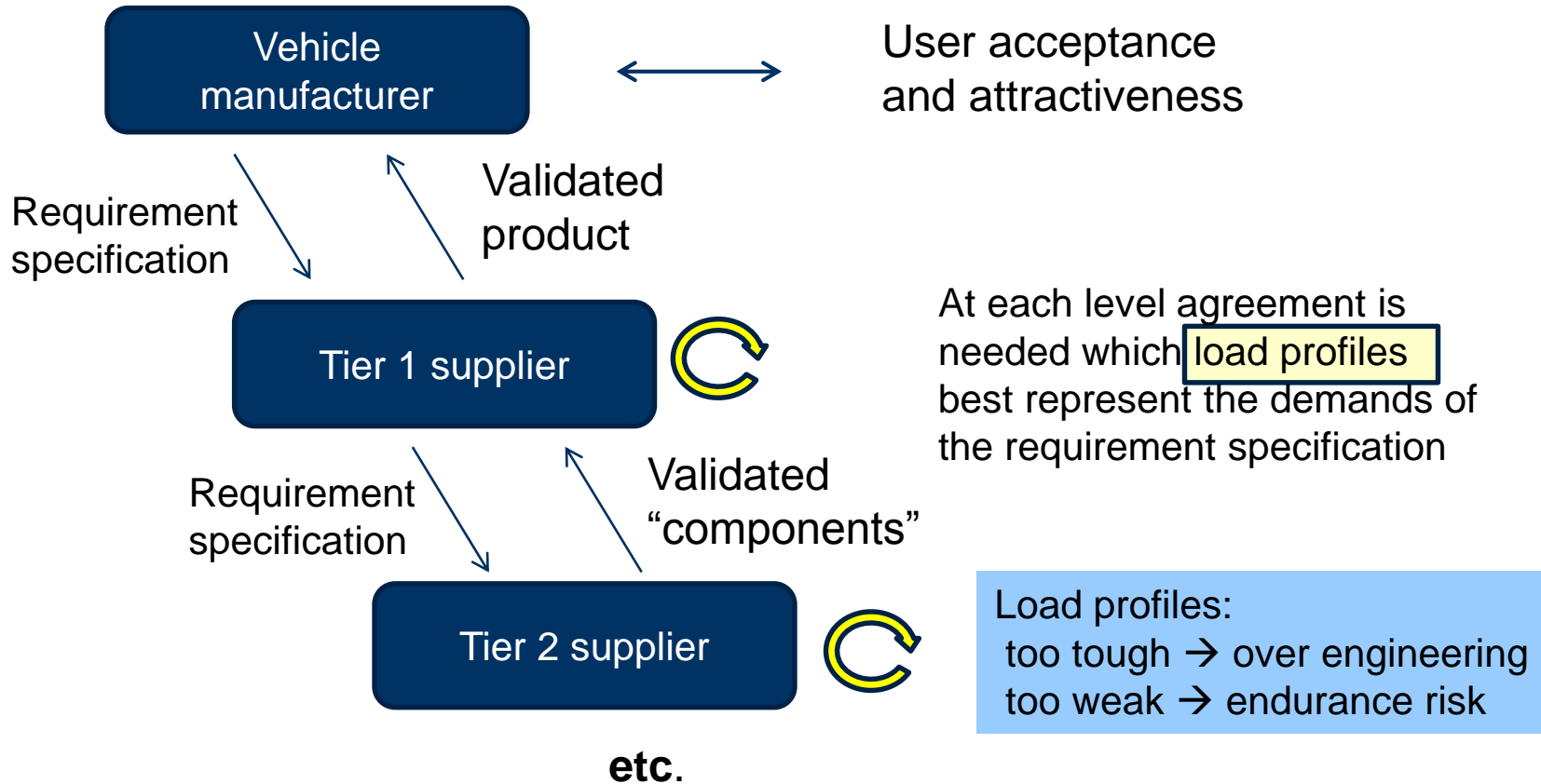
Role of Testing in the Development Process

- keeping the classic V-Model in mind:



The primary **goal of testing** is to confirm that the product meets the requirements of the customer both in terms of functionality and safety.

Extensive Testing throughout the Value Chain



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Typical Supplier Testing of “Components”

- ranges from “system”-testing (functionality) to “component”-endurance

Scope of standard testing to release products for series production:

- Functionality (incl. leakage, etc.)
- EMI/EMC testing
- Endurance/Lifetime testing
- Environmental testing
 - ...
 - ...
 - ...
- Limit samples
- Testing in vehicles



Environment test rig for power electronic units

Testing sequences :

- Function & sealing
- Temperature shock
- Temperature storage
- Water ingress
- Leakage resistance
- Disassembly
- Vibration with noise excitation

- Shock test
- Functional test
- Autoclave test
- Pressure threshold test
- Burst pressure test
- Leakage tests
- Salt spray test

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Particular Challenge for Testing Electric Vehicles

- electrifying the power train adds new dimensions of complexity to the system:

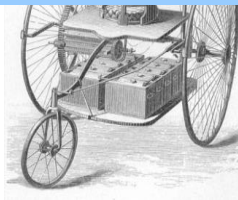


Fitting components into

New Urban vehicle concepts with highly integrated solutions



Designing the electric vehicle bottom-up means significant changes to the most important input “requirements” and load profiles that directly influence how testing is carried out.



First cars were designed for electrification



Redesigning vehicles specifically for EV optimization



Added Dimensions of Complexity

- increase the search space for relevant load profiles:

1) Testing of components for conventional vehicles can be considered “linear” based on experience for the last 125 years.



2) Adding electrification to the power-train results in a two-dimensional search space for load profiles.



3) Finally new vehicle concepts with increasingly high integration of components result in a “search volume” for future testers.

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Summary & Key messages of Supplier

- *Electro-Mobility poses new challenges for testing due to the high variability of system designs due to the new dimension added by the electric motor.*
- *A further increase in variability is expected when the industry starts implementing new vehicle concepts such as light urban vehicles.*
- *R&D in the area of testing is needed to better understand the new demands on testing that result from a degree of variability that has never been seen before in the automotive industry.*
- The particular challenge is to **identify and implement changes in load profiles** on systems, components and individual parts that influence functionality and durability.
- Extensive R&D is needed here to better **understand the failure mechanisms** that damage parts and components at every level of the value chain - from new vehicle design concepts to the tier 1 components and further down the production chain.
- Furthermore R&D is needed for **new testing equipment** that has to be adapted to generate these new load-profiles (e.g. higher rpm).
- Finally **higher system integration** may result in test equipment that **has additional demands on environmental conditions** (e.g. oil not only lubricant but as coolant in e-machines).