PERSIST – An AUTOSAR-based powertrain control SW product line

prepared for:

7th AUTOSAR Open Conference

Detroit, MI, 2014-10-23
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Agenda

- Introduction and motivation
- FEV SW strategy
- Application examples
- Summary and Outlook
FEV’s application areas
Diverse powertrain applications, SW development is cross-function

Software development since 15 years

- Application overview via functional experts
- Cross-function for production code
- Project-driven business model/services

Gasoline Engines  
Commercial, Industrial, Large Engines  
Electrics/Electronics  
Test & Instrumentation

Business Region Europe

Business Region East

Business Region US

RE  
RO  
RU

BG  BD  BC  BV  BE  BA  BT

BUSINESS UNITS

Diesel Engines  
Passenger Cars  
Vehicle Chassis & Transmission  
Advanced Applications

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Software complexity raises, calibration is steadily more effort, → Software development costs increase

How to reduce code complexity?
How to reduce calibration effort?
How to ensure quality under market conditions (variants, time&cost pressure)?


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AUTOSAR strategy
Enable reuse by combining standards and customer needs

- Make software independent of hardware
- De-couple software development
- Increase software re-use through standardized basic software

Source: AUTOSAR, 2013
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New software business models
More software share by OEM and service suppliers

Increasing SW sharing by OEM / Tier-x

- Tier-1 SW fraction will decrease

Required: SW competences
- System integration
- Supplier management
- Functional powertrain excellence

Challenges
- OEM: investment in own structures vs. low costs today
- Tier-1: multiple customers/OEM → multiple variants, how to keep consistency
- Both: legacy code, architecture reflects organization

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Software strategy
PERSIST
FEV’s SW product line strategy

Powertrain control architecture Enabling Reusable Software development for Intelligent System Tailoring

Bring reuse to projects

Consistent Architecture by common design instruments

Follow relevant quality standards

Integrated tool support for the entire development

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PERSIST
FEV’s SW product line strategy

Powertrain control architecture Enabling Reusable Software development for Intelligent System Tailoring

Bring reuse to projects

Follow relevant quality standards
ISO25010
ISO26262

Consistent Architecture by common design instruments

Integrated tool support for the entire development

config quality
release tests

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AUTOSAR Overview
Main elements and standardization status as of 2014

J. Richenhagen: Entwicklung von Steuerungs-Software für den automobilen Antriebsstrang mit agilen Methoden, Dissertation RWTH Aachen University, to be published 2014
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AUTOSAR specification status: focus Basic Software
Application Layer open to innovation, especially for powertrain

How to fill conceptual gaps for powertrain domain?

- SW module
- standardized interface
- interface type
- BSW-relevant
- RTE-relevant
- VFB-relevant
- Powertrain-relevant functions
  - specified and standardized
  - partially specified
  - not addressed

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Architecture specification instruments: Basis AUTOSAR
Fill architecture gaps through consistent approach

- Design Principles: functional scope for architecture elements, hierarchical error management
- Design Concept: model frame generation, access for automation
- Design Pattern: Component-Based, reflection of physical components, wrapper for project work
- Base Architecture: modularity, information hiding, design for change
- Reference Architecture: standard compliance is the base for architecture development
PERSIST design patterns
Align project business and SW standardization by wrapper concept

Interface mismatch
- e.g. different signal naming
- customer conditions
- solution

Interface unclear
- e.g. Basic SW not specified yet
- project situation
- solution

Adaptation strategy
- introduce project-specific components where required
- keep interfaces of core components stable

Benefit
- adaptability to customer needs
- flexibility in projects
- reusable core components
Applications
Software architecture for FEV Diesel controls (simplified version) → Engine system physics, control strategy & software architecture match

- Cyl: in-cylinder calculations
- ExVlv: Exhaust Valve
- InVlv: Intake Manifold
- ExMfd: Exhaust Manifold
- IntMfd: Intake Manifold
- ExO2C: Exhaust oxygen concentration
- EgrHp: high pressure EGR
- NOx based EGR coordinator
- TcHp: High Pressure Turbocompressor Stage
- ThrD: Throttle Valve
- OxC: catalyst
- PFit: DPF
- Doc
- MAF: Air Mass Flow Sensor/weighting
- Air Flt: Air Filter

Physical based component
Logic component

Dp – boost setpoints

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Software architecture for FEV Diesel controls (complex version)

Component reuse and scalability
Software architecture for FEV Transmission Control
Sustainable development over different projects
Summary and Outlook

Challenges
- Rising SW complexity & costs
- Industry answer: standardization
- Result: more SW players (OEM, Tier-x)

Approach: FEV expands AUTOSAR to powertrain applications
- PERSIST as a SW product line
- AUTOSAR lacks powertrain specification for application layer
- Achievement: AUTOSAR expansion with consistent guidelines

Outlook: SW product line, architecture-driven development
- Observe evolution of AUTOSAR in powertrain domain
- Projects will be more configuration & architecture-driven
- Ease product line handling via database approach
Thanks for our attention!

Questions? → ask now or email
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