MbD for powertrain systems
From concept to production

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Agenda

- Introduction
- Motivations and challenges
- Model-based Design: why’s necessary?
- Product Innovation
- PowerTrain MbD toolchain
- Future developments
Introduction

**MOTIVATIONS**

*What we make different*

- **Innovation**
  Develop exclusive Lamborghini software functions and Keep know-how in-house

- **Independence**
  Possibility to develop single software functions to use in different applications

- **Integration**
  Share software libraries within VW group

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**CHALLENGES**

- Brake with the past adopting a formal method to the software development
- SW functionalities development in-house
- Internal and external collaboration
- Cost and time development savings

Over the years Lamborghini Powertrain team has implemented **Model Based Design (MBD)** methodologies for in-house software development

The MbD methodologies is able to achieve the PWT objectives:

- **Saving** development time and costs
- Gaining **know-how** internally
- **Re-use** know-how for different project
Motivations & challenges

➢ Speed up development of new concepts

➢ Methodologies and unified toolchain for code production

1. Competitiveness
2. Intellectual property
3. Technology know-how
4. Exclusive product
Model-based Design: why’s necessary?

Why Model based design is useful

**COMPLEXITY**
- of component and technology driven mainly by customer functions and efficiency requirements.
- of innovative technologies show several component updates during the vehicle life cycle
- of function network for torque control management

MBSE allows productive cooperation with stakeholders, improving quality, increasing productivity and reducing risk.

Model-Based Systems Engineering is the formalized application of modeling to support system requirements, design, analysis, verification and validation activities beginning in the conceptual design phase and continuing throughout development and later life cycle phases.”

INCOSE SE Vision 2020 (INCOSE-TP-2004-004-02, Sep 2007)
Product Innovations

«Model Based Design has allowed evident benefits in function development producing a new mentality to the software design»

KERS torque management whole designed in Matlab along with Gallardo engine torque control

Challenge: prototyping

On Aventador series production the VVT function was performed

Challenge: Production Autocode, Fixed Point

Continuos integration for unifying autcodoing process development

Challenge: MbD tool for SW development process, project collaboration

On Aventador series production the pull-aways functionality was integrated inside the engine control structure complied project.

Challenge: autocode integration

Kers

2010

2020

2012

2013

VVT

Pullaway
**Software Development Process**

**MbD** approach has allowed to establish the links between the different steps automatizing the methods gaining in benefits in respect of the customer demand’s coming up like

- Compliancy (ISO26262, ISO 15288)
- Product Quality (ISO9001)
PowerTrain MdB Tool

How tool works

- Linking requirement to documentation (V&V)
- Model (SLK, ML, SF)
- Implementation
  - MAAB rules guideline check
- Sync model version to GitHub
- Analysis (V&V)
  - MIL vs. SIL
  - Test coverage
- SW Specification (ReportGen)
- Code Generation (ECoder)
  - Target customization
  - Library implementation

Is it possible to integrate data for function development?

«By using Mathworks products the function development process automation it was possible raising in effectiveness and efficiency in the early stage of development»

Features

- Distributed app
PowerTrian Mdb tool in action

- Video 1 Tracebaility (model, requirements, code)
- Video 2 Testing Model (Coverage Analysis)
Future developments

PowerTrain MbD toolchain enhancements:

- System Architecture (database)
- Model Requirements
- Consistency checks of custom MAAB rules
- Distribute App
- Project Collaboration
Thanks for your patience