Virtual Prototyping

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Agenda

- Challenges
- Digital Product Development Process
- Modular Principle
- ANSA “150%” Model
- ANSA “generic” connecting technology
- Conclusion
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- Challenges
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Challenges!

- variant diversity
- high complexity
- a lot of digital prototypes
- different CAE-disciplines
- cross-linked timetable
- short set-up time
 Variant diversity

C2 Coupe      C2 Cabrio      C4 Coupe      C4 Cabrio      C4 Targa

markets      drivetrains      gearboxes      engines      chassis      seats

Top Coupe      Top Cabrio      GT2 RS      GT3 R Hybrid

Virtual Prototyping
Variant diversity

Boxster

Top Coupe

Cayman

Virtual Prototyping
A lot of digital prototypes
Virtual Prototyping

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Philosophy

Concept development → Series development

- no concept confirmation without digital coverage
- no hardware without digital coverage
- no testing without digital coverage


**The digital process is key during the development phase**

**Virtual Prototyping**

- Concept development
- Series development

**Numerical simulations for layout and confirmation**

- Process driven by digital prototypes

**Tooling**

- Tooling Assembly Prototypes
- Tooling Serie

**Crash tests**

- Crash testing as example

**Crash tests**
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Modular principle “an old idea”
Modular principle at Porsche

- **Colorado Project** (1999)
- **Interlocking 996/986** (1994)
- **Porsche COP-Management Panamera** (2006)

Projects in the VW-Group
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Modular principle with ANSA

The concept: BiW Configurations

Sportscar

Model Variants

Coupe

Cabrio

...
### Modular principle with ANSA

<table>
<thead>
<tr>
<th>Z1</th>
<th>Common parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platform</td>
<td></td>
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<table>
<thead>
<tr>
<th>Z2</th>
<th>Mutual exclusive parts</th>
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<tbody>
<tr>
<td>Platform framing</td>
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<tr>
<th>Z3</th>
<th>Shifted parts</th>
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<tbody>
<tr>
<td>In case of long &amp; short variants of a model (not existing in this example)</td>
<td></td>
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</tbody>
</table>

Virtual Prototyping
Workflow

CSV file
Vehicle-variant
Product tree

Custom developed ANSA script

Part Manager
Model tree

Product tree editor

Translation of CAD Data
with automatic assignment
of part attributes

CAD Data pool

Variant BiW ANSA db

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Example

Coupe ANSA db – part manager hierarchy

Cabrio ANSA db – part manager hierarchy

Compare Tool

150% Model Part Manager hierarchy

Virtual Prototyping
Example
Modular principle Connections

Creating the 150% model connection information

Coupe xml Connections file

Cabrio xml Connections file

150% Model Connection File

Custumed developed ANSA script
Modular principle Connections

Z1
Platform

Z2
Platform framing

Z3

Common Connection points

Mutual exclusive Connection points

Shifted Connection points

In case of long & short variants of a model (not existing in this example). They are shifted automatically if the parts they connect are also shifted.
Modular principle Connections

- The ANSA DM Configurator activates/deactivates the connection points automatically, taking into consideration the participation of the connected parts to the active configuration.

- A connection point is activated only when all the parts it connects belong to the active configuration.

- The connection points connecting only common parts are defined once.

- The connection points connecting mutually exclusive parts to common parts should be defined multiple times (once for each configuration).

- The status of the connection points remains intact regardless of their activation status.
Advantages of ANSA DM Configurator

- During the build-up of the models, we avoid performing multiple times all the time-consuming processes concerning the common parts of the models (such as connection points check, penetration check, definition of solver dependent entities).

- During the database maintenance, it is easier to maintain one database instead of multiple (for example, when exchanging one version of a common part with a newer one).

- The automatic activation and deactivation of connection points according to the configuration.
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**Connection Manager**

Weld and Joint Entities and Assembly Tools

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**Point Connections**
- Spot-welds
- Bolts
- Gumdrops
- Kinematic joints

**Line Connections**
- Glue
- Arc-welds
- Hemmings

**Surface Connections**
- Glue

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**Connection Manager Entities**
- Spot-weld points/lines
- Bolts
- Gumdrops
- Adhesive Lines
- Seamlines
- Hemmings
- Adhesive faces

Definition of weld and joint entities:
- From input of connection files
- Interactively on the model

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Virtual Prototyping
Connection Manager
Weld points and lines FE-representations

Spotwelds - Mesh independent
Adhesives – Hexas
Seamlines - Elements arc-weld
Hemmings - Folded shell elements
Connection Manager

- From bolt geometry
- From tubes

Numerous realization patterns
Connection Manager

By number of parts
By connectivity
By type
By status
By FE-representation
By connection file
By diameter
By template

Virtual Prototyping
Connection Manager
Assembly scenario and realization for different disciplines and solver

1. Connection grouping
   - Location
   - Connected parts
   - Diameter etc.

2. FE-rep templates assignment
   - Standardized settings
   - Direct realization
   - Library of scenarios for each discipline/solver
Connection Manager
Realization for different disciplines and solver

Crash Template for LS-DYNA

NVH Template for PERMAS

Fatigue Template for PERMAS

Virtual Prototyping
Advantages of ANSA Connection Manager

- Possibility to enter and maintain in our CAE model a variety of additional attributes that concern the connection itself. (e.g. at adhesive line we are able to store the glue material)

- By organising our connections with ANSA templates we are able to group them according to the FE representation that we will use for them in the model. (e.g. different templates for spotwelds, clinchen and rivets although all of them belong to the same connection type "Connection Points".

- By using assembly scenarios we are able to assign our connection generic entities various templates, depending on the discipline (crash, NVH, etc) in a fast and error free way.
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Conclusion

- The variant diversity, the number of digital prototypes and the cross-linked situation is a big challenge for the CAE disciplines
- It is necessary to translate the modular principle into the virtual world
- We need multi-discipline-solutions in the model-setup phase
- There are solutions in ANSA for the modeling-process
- This means high requirements to the surrounding processes CAD, DMU, SDM, PDM, …
- We need high experienced people with a high responsibility to run this process