χMCF v3.0: An Interface Standard for Exchanging Weld* Information within CAD/CAE

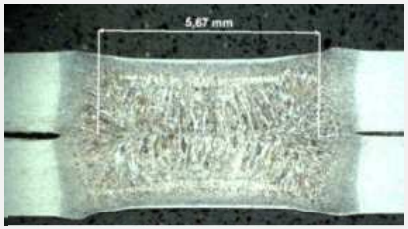
* and beyond

Munich 2019-05-21, Dr. C. Franke (PROSTEP AG), Dr. G. Zhang (Volkswagen AG)

Challenging Joining Technologies & Processes

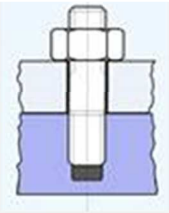
Challenges wrt. Connection Information
Big Variety & Complexity

- > 60 known connection techniques.
- Up to 25 quality criteria per connection technique.



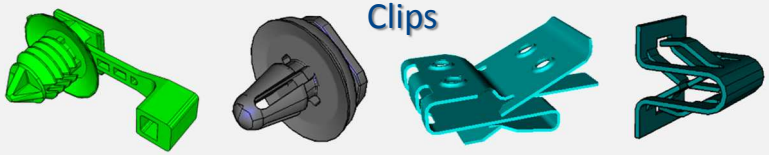
Section of a Spot Weld

Some Screws …

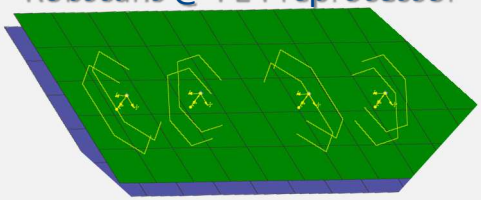


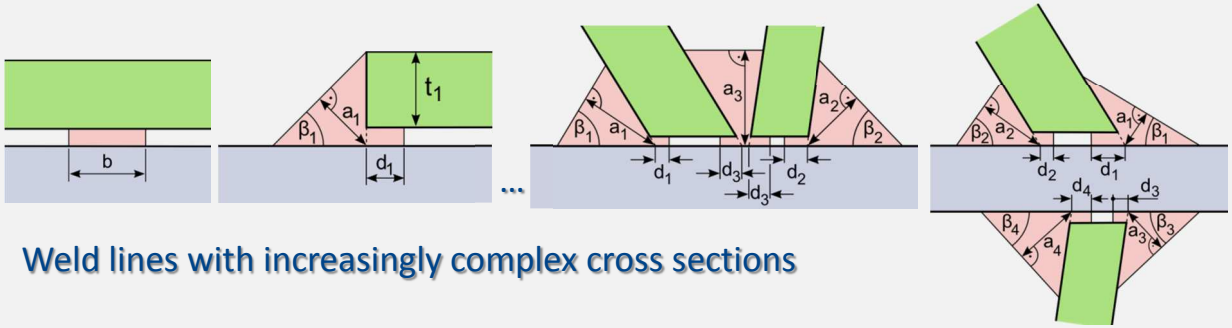

Rivets

Clips



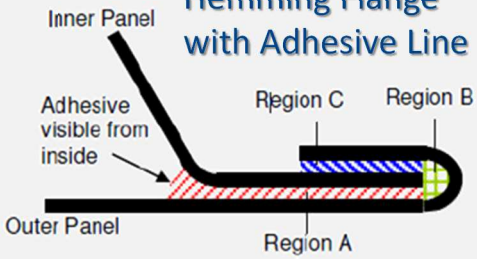
Robscans @ FE Preprocessor

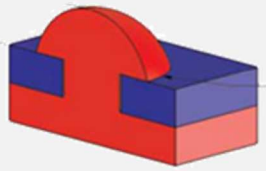




Weld lines with increasingly complex cross sections

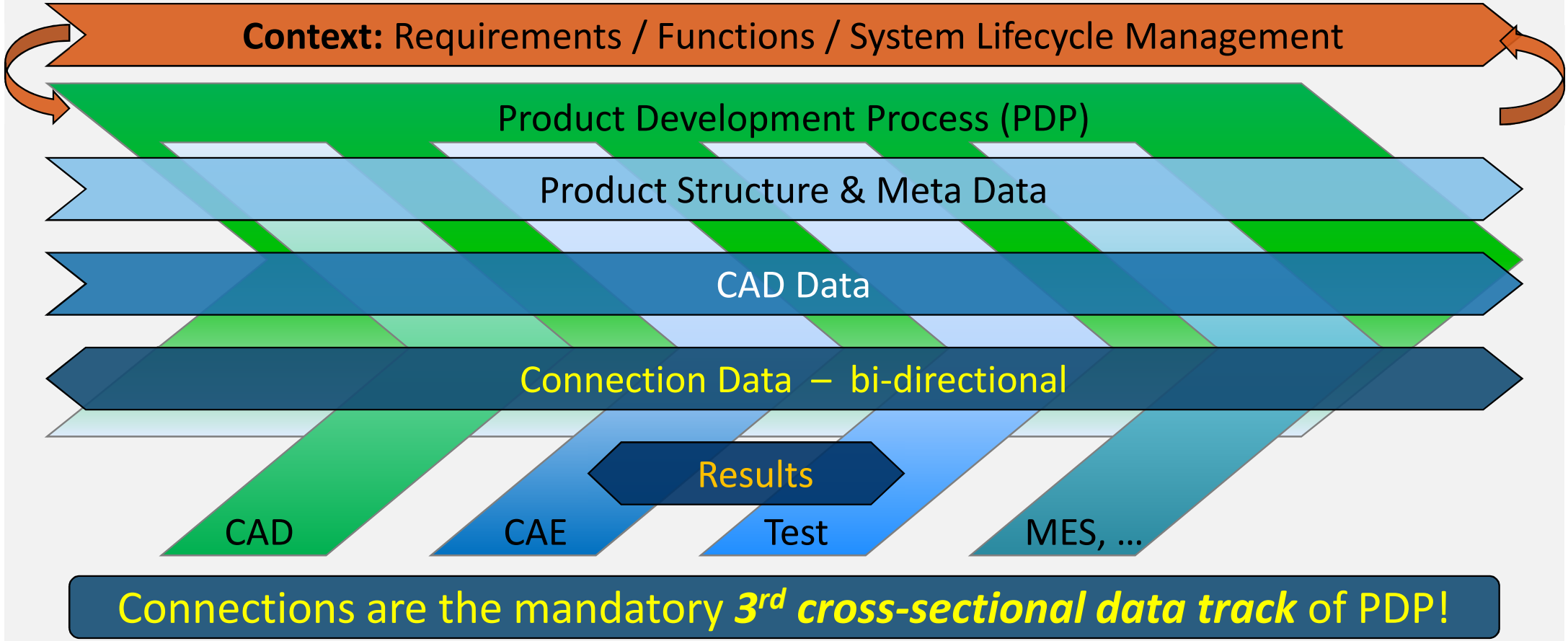
Hemming Flange with Adhesive Line





Heat Stake

Challenges wrt. Product Development Process



Connections are the mandatory ***3rd cross-sectional data track*** of PDP!

What is so Special about Connection Data?

Connections differ from product structure, meta data and CAD data, since e. g.:

function dominates over their shape	need more *PLM upstream data propagation* than CAD	work needs different *tools & plugins*, special *process steps* and expert *knowledge*
belong to *inner nodes* of product tree, not to its leaves	*data size* is much smaller than CAD data	CAD and connections *complement each other*. Each is *useless without the other*.

What are the Frequent Problems?

- Every OEM creates *own CATIA/NX macros* or buys *proprietary software*.
- Common suppliers *need to be familiar with all of those* tools.
- Data exchange along process chain needs *additional tools*, frequently “home-brewed”.
  ➔ Expensive and error-prone.
- However, in reality only *few techniques* are supported with only a *fraction of their data*.
- Inventing new techniques or adding new parameters results in *excessive costs* and *process threats*.
- Changing software vendors implies *high investments*.

➔Resulting “*vendor lock-in-effect*” impedes competition and hence *hinders progress*.

χMCF – the Enabler for Smooth Processes

χMCF: *The* Standard for Connection Information

VDA FAT | Forschungsvereinigung Automobiltechnik **AK 25** | **Fügetechnik** defines and maintains χMCF.

XML-based χMCF meets all "usual" requirements to a standard, plus:

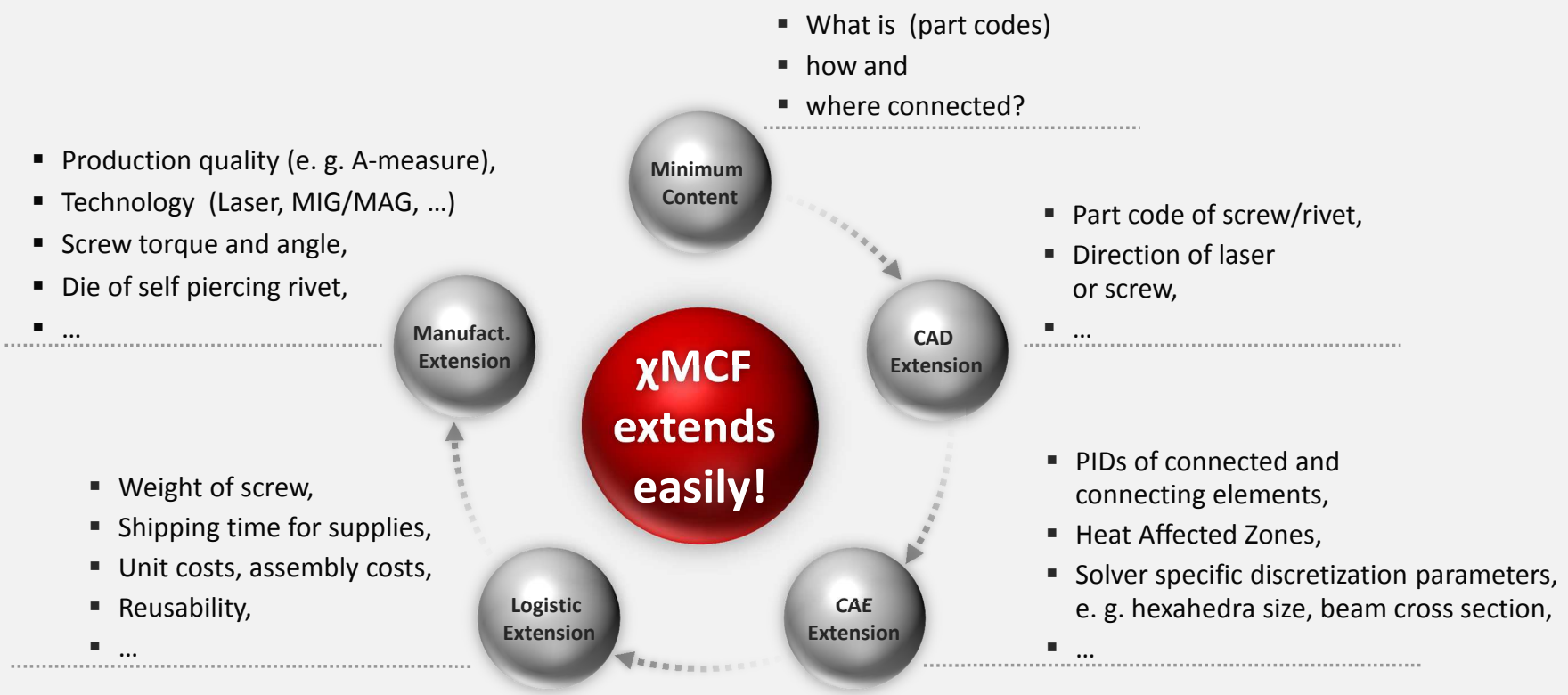
- All connection types & techniques can be represented.
- All PLM processes are supported – CAD, CAE, CAT, Manufacturing Planning & Execution, including special sub processes, e. g.:
  - Durability simulation,
  - Robot programming,
  - Supplier integration, …
- One χMCF-file contains either data of one *assembly*, one *car* or all *variants* of a series .
  ➔ χMCF meets any kind of *OEM specific process* design.
- χMCF allows imbedding *custom data* specific to *OEM, process* and *tool*.

➔ All existing proprietary formats can be replaced sustainably.

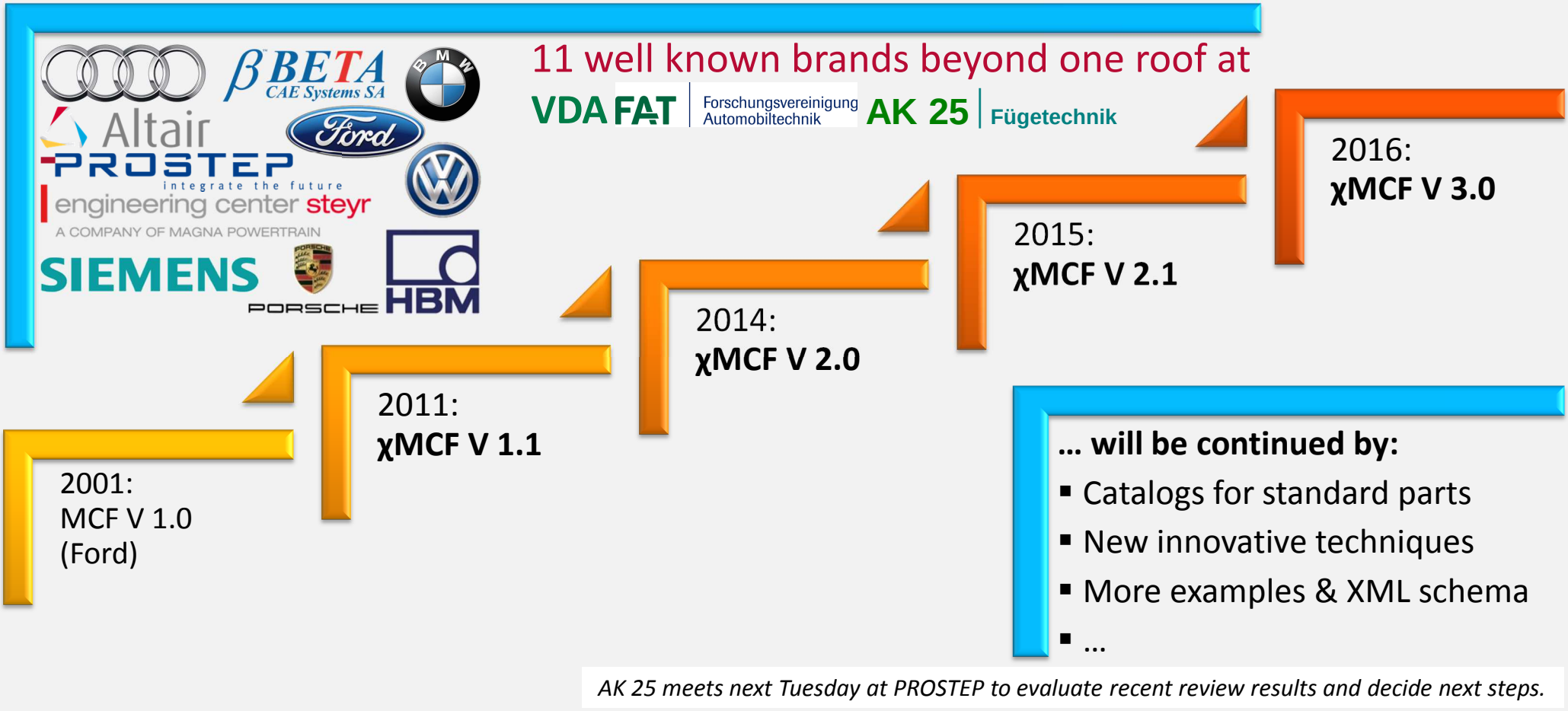
- VDA: German Association of the Automotive Industry
- FAT: Research Association for Automotive Technology; department of VDA
- AK 25: Working Group 25; focus on joining technologies

Download χMCF Standard at VDA web site: https://www.vda.de/de/services/Publikationen/fat-schriftenreihe-286.html

χMCF Accumulates Data along the Process Chain



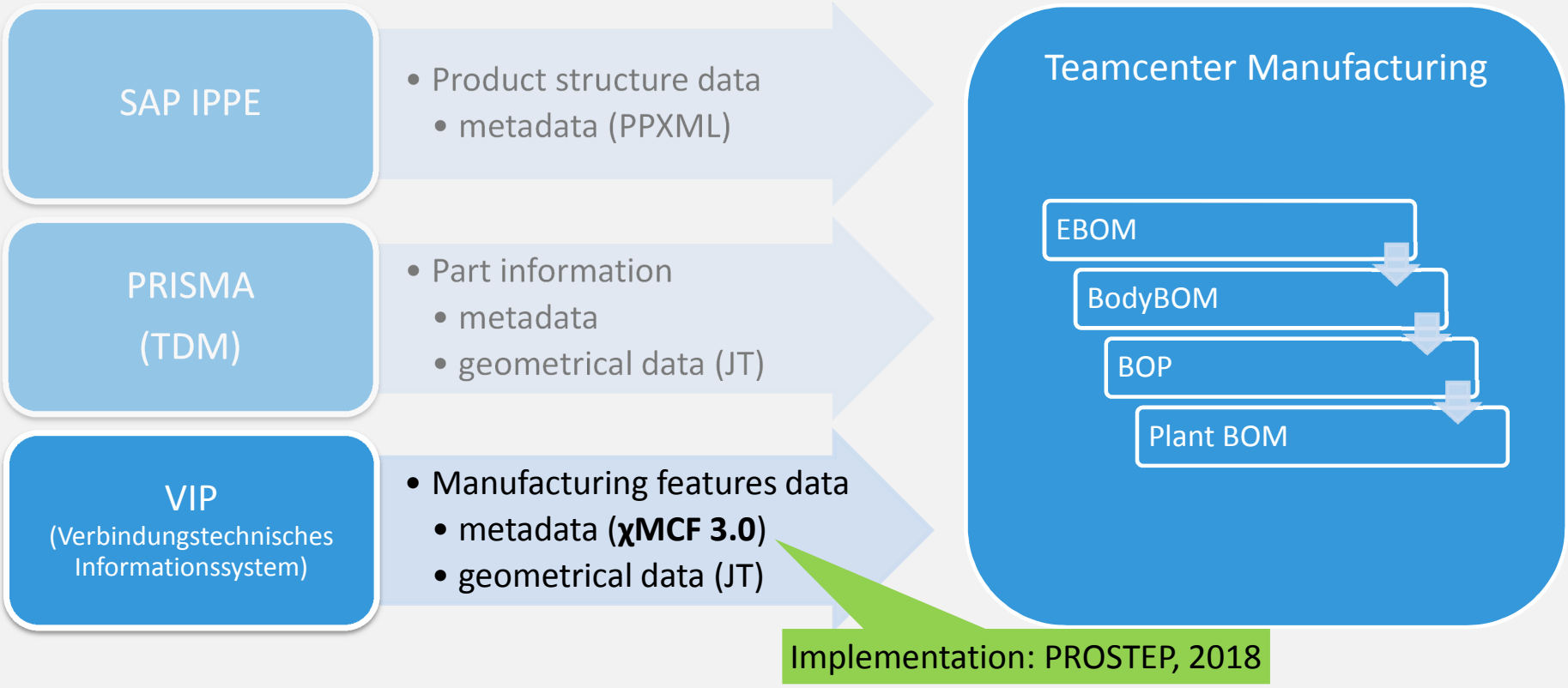
χMCF – A Standard with History and Broad Support



Strategy & Example Use Cases at BMW

BMW decided to *replace old VIP 2 format* by χMCF 3.0.

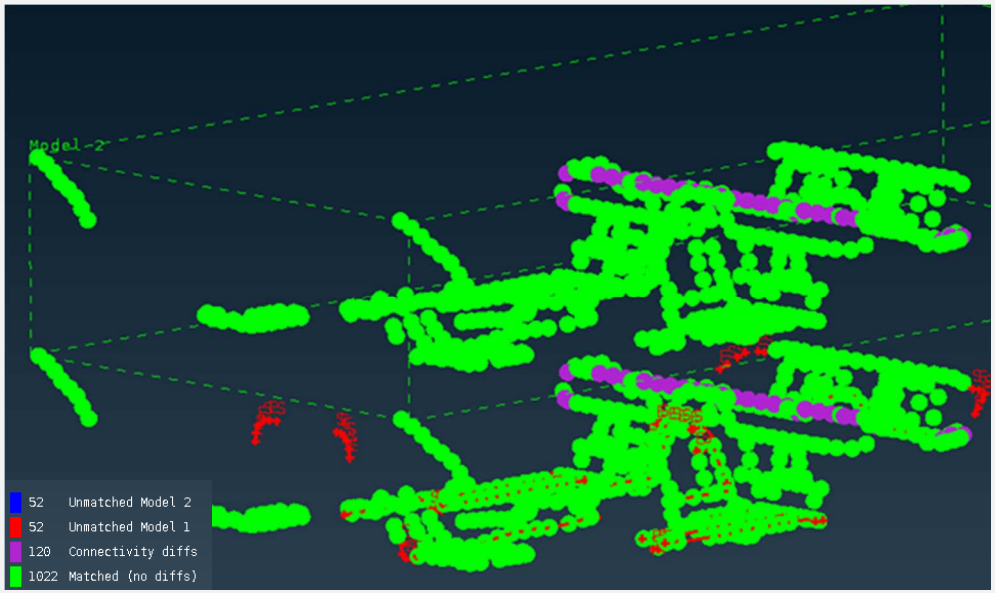
Use Case @ BMW: χMCF Data Exchange between PDM & Production Planning



BMW χMCF Strategy

- Production Planning (Teamcenter Manufacturing) has been addressed 2018 – supported by PROSTEP AG.
- This year, CAE is addressed – supported by BETA CAE.
- Data for CAE will contain technology parameters, e.g. weld shape.
- Other core business processes will follow.

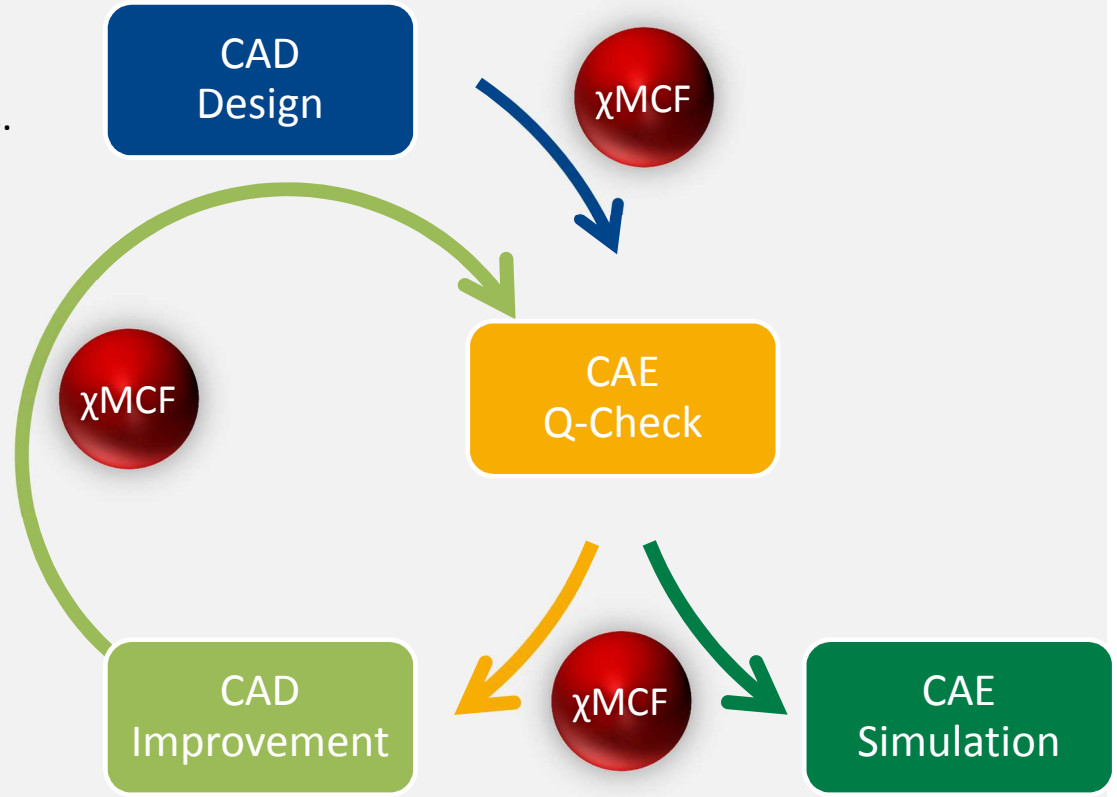
ANSA acts as a *verification tool*, comparing VIP & χMCF data:



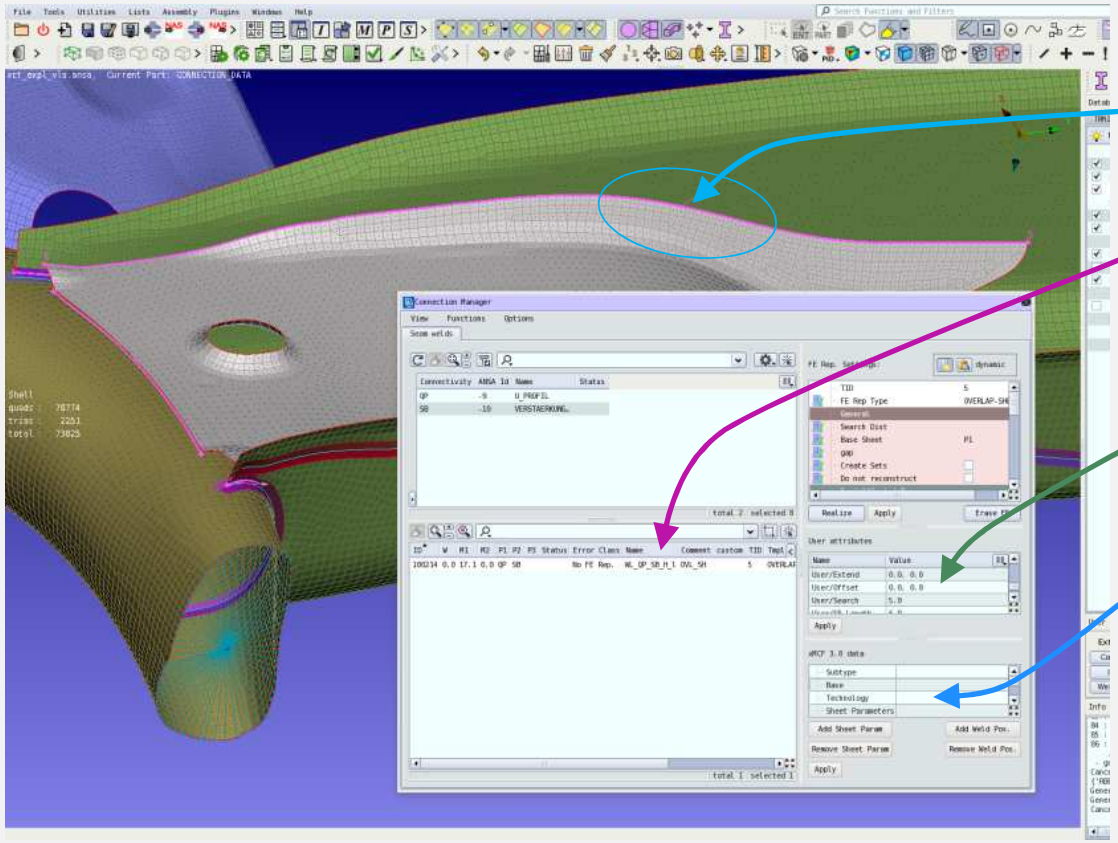
Example Use Case at Volkswagen

Use Case @ at Volkswagen: Quality-Gate between CAD and CAE – Enabled by χMCF

- Frequently, a complete digital vehicle is assembled *in CAE for the first time* in product development process.
- Using χMCF, connection data can be provided to CAE in the most *automated and low-error fashion*.
- Powerful features of a preprocessor like ANSA allow for *automated, fast and reliable quality checks*.
- Custom scripts provide *custom error categorization*.
- Via χMCF, categorized quality issues can be *sent back to design*.
- Categories allow CAD to fix the issues by a defined and *plannable process*.



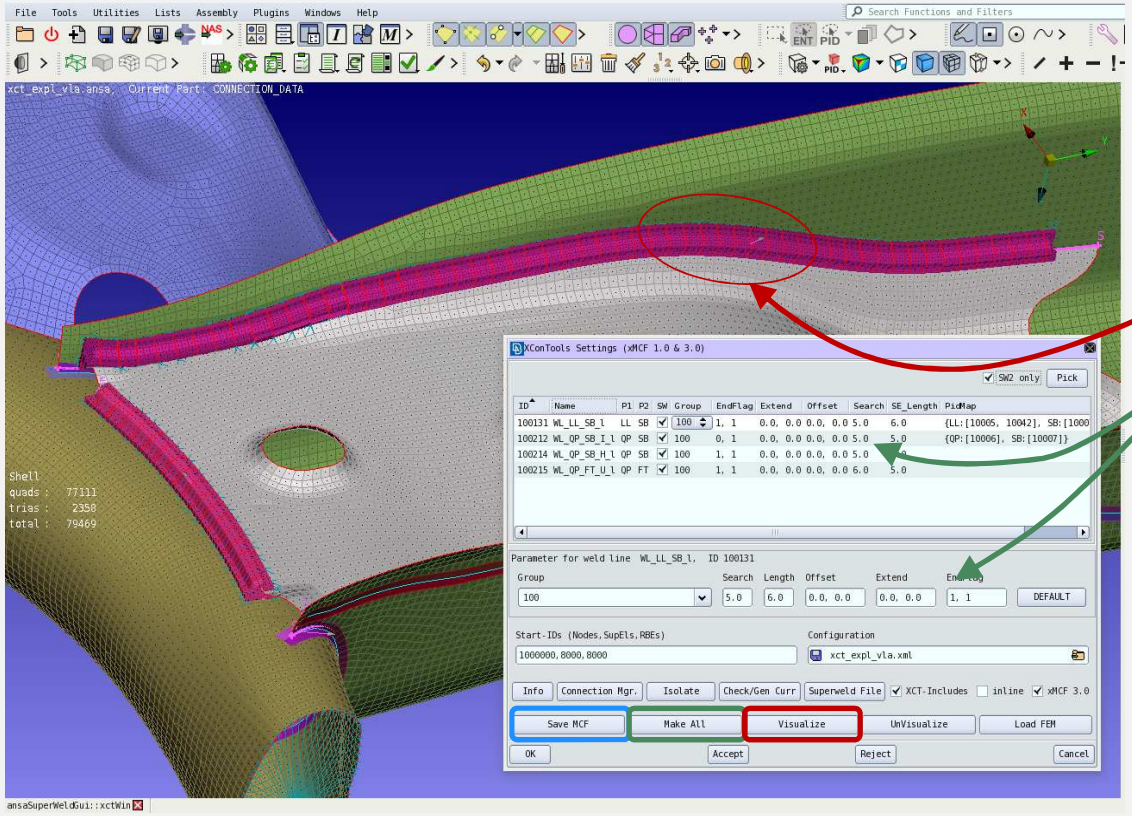
Use Case @ at Volkswagen: Quality-Gate between CAD and CAE – Step 1



Step 1 with **ANSA connection tools**

- create seamline by *ANSA connection creation tools*
- set up geometric information, e.g. weld direction, using *ANSA connection manager*
- set up site and tool specific data using *custom attributes*
- provide native *χMCF data*
- proceed using *site specific ANSA macro*

Use Case @ at Volkswagen: Quality-Gate between CAD and CAE – Step 2



Step 2 with **site specific control panel**

- Save χMCF
- Start FE representation process: Make All
- Visualize and check FE-representation
- If necessary, adjust the connection parameters for individual connections.
- Extend the solver deck with the connection's FE-representation using *outputPre* and *outputPost* functionality.
- Send failed/corrected connections back to CAD via χMCF – specifically attributed.

χMCF @ ANSA

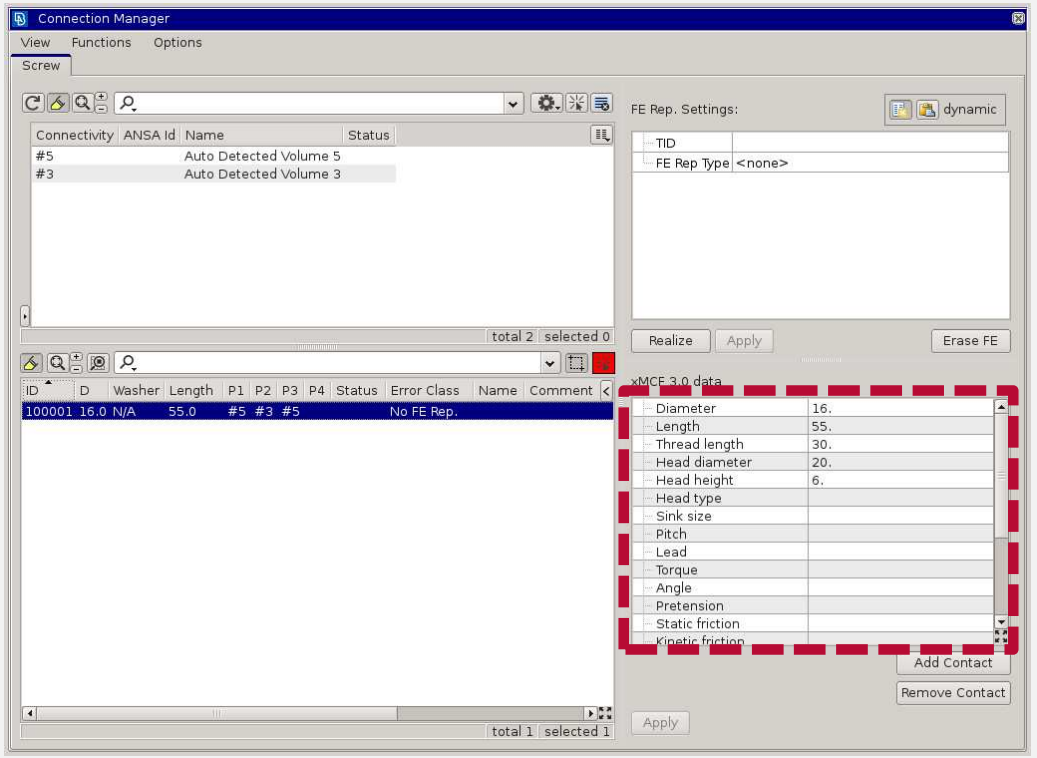
Status & Outlook at ANSA PRE PROCESSOR

PROSTEP VOLKSWAGEN

- ANSA continuously extends χMCF support since years.
- ANSA V.1911 introduces support for Rivets and Screws according to χMCF 3.0:

Rivet – Screw

- In 2020, χMCF attributes will determine FE-realization, e.g.: “Self-piercing rivets with hardness > 100 get a special PID”.



Disclaimer: PROSTEP and Volkswagen are not liable for this information, provided by BETA CAE.

Summary

- Connection processes are *rich and manifold* – so are the data.
- χMCF 3.0 is *the* powerful and mature standard for piping connection data forward and backward through the product development process.
- It is able to *bridge any gap* between process steps or tools.
  – As has been shown by example applications at BMW & Volkswagen.
- Many *important tools already support* χMCF 3.0 – more to come.

➔ PROSTEP offers support when *optimizing your processes to benefit* from χMCF 3.0.

➔ More *demand placed at software vendors* will lead to even wider support of χMCF.

VOLKSWAGEN
AKTIENGESELLSCHAFT

PROSTEP
integrate the future

Thank You!

PROSTEP AG

Dipl.-Math. Dr. **Carsten Franke**
Carsten.Franke@prostep.com – Mobile: +49 151 500 36868
Wankelstr. 14/II, 70563 Stuttgart

www.PROSTEP.com

Volkswagen AG

Dr.-Ing. **Genbao Zhang**
Genbao.Zhang@volkswagen.de – Mobile: +49 152 52596103
EXB/1, 38436 Wolfsburg

www.volkswagen.de