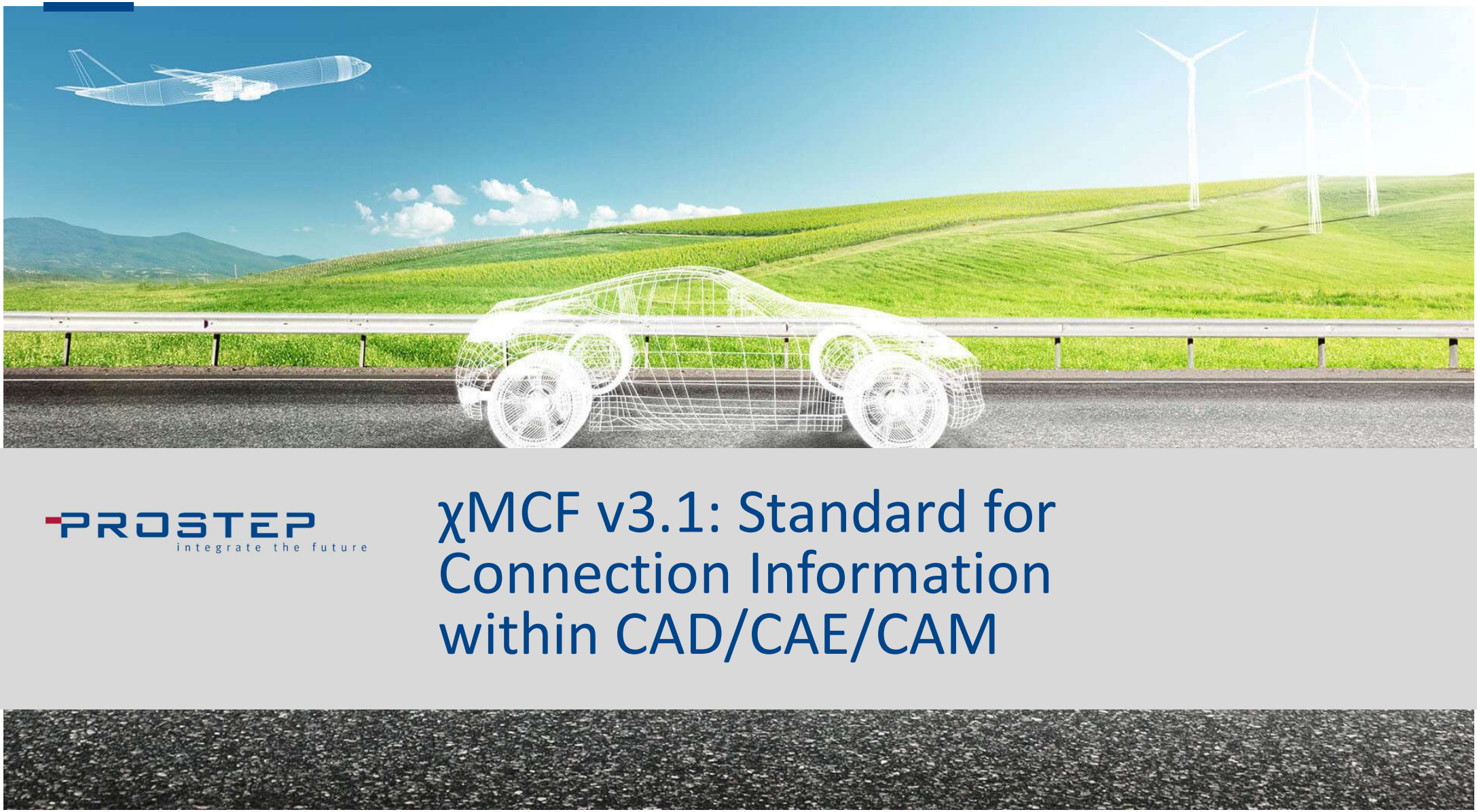


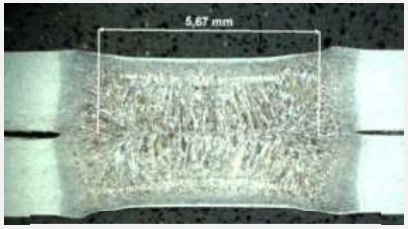
PROSTEP
integrate the future

χMCF v3.1: Standard for Connection Information within CAD/CAE/CAM

Challenging Joining Technologies & Processes

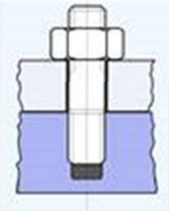
Challenges wrt. Connection Information
Big Variety & Complexity

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



Spot Weld (Section)

All kinds of screws

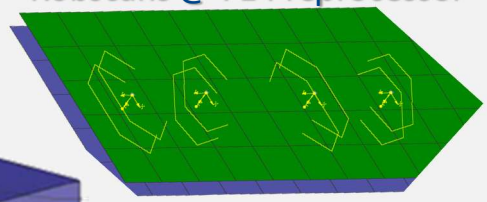


Rivets

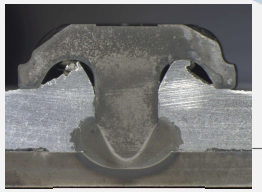

Nails

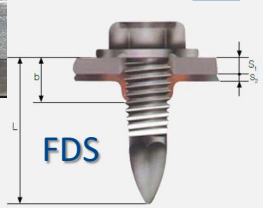
Clips

Robscans @ FE Preprocessor

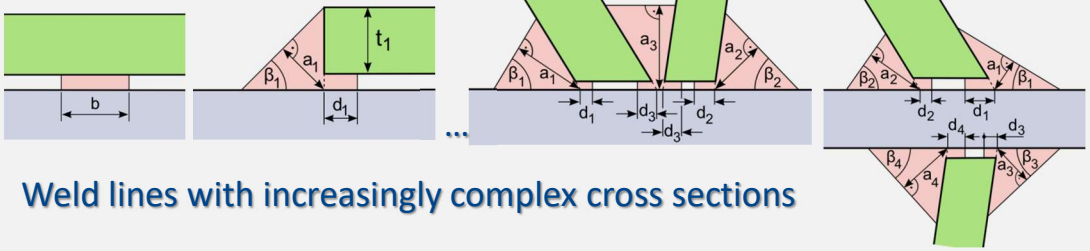



Clinch Rivet Stud


ROTAV

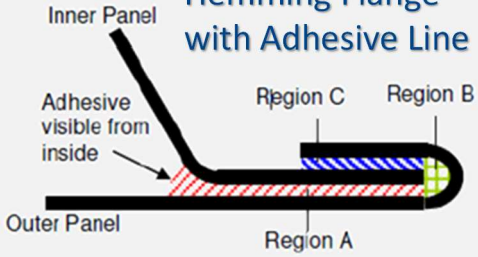

FDS


Heat Stake

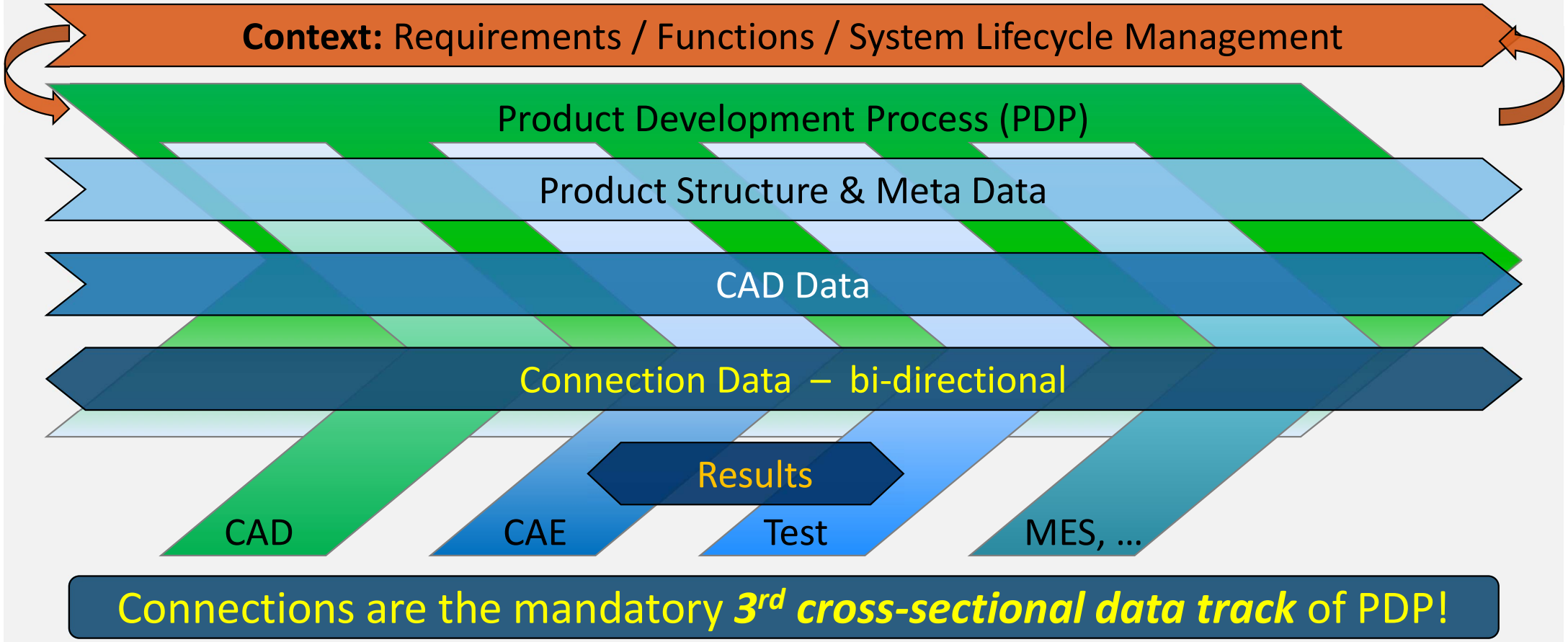


Weld lines with increasingly complex cross sections

Hemming Flange with Adhesive Line



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 **(incl. long-time ability!)**, plus:

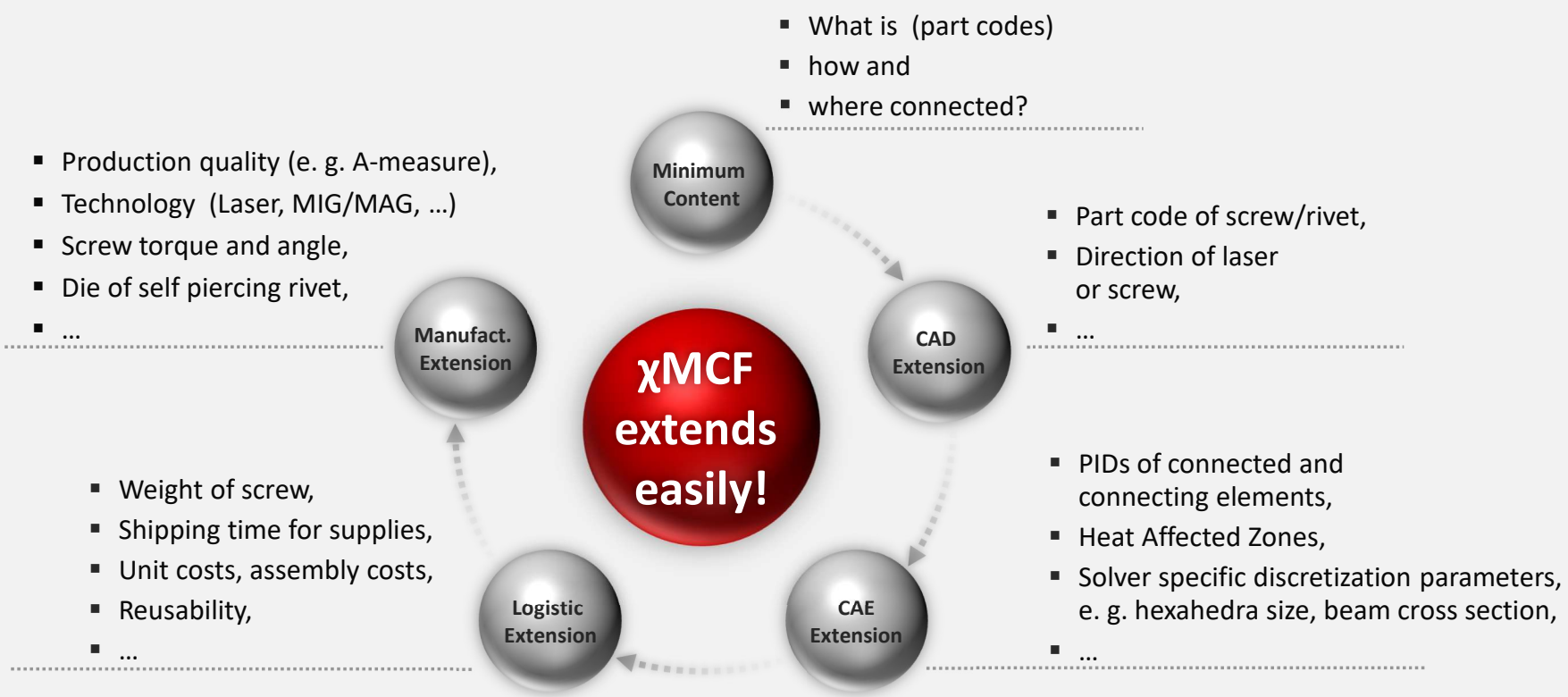
- All connection types & techniques can be represented.
  – Unambiguous, completely, exact, and to the current design maturity.
- All PLM processes are supported – CAD, CAE, CAT, Manufacturing Planning & Execution, including special sub processes, e. g.:
  - Durability simulation,
  - Robot programming,
  - 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 3.1 Standard at VDA web site: https://www.vda.de/en/services/Publications/Publication.~1654~.html

χMCF Accumulates Data along the Process Chain



χMCF – A Standard with History and Broad Support

Well known brands beyond one roof at

VDA FAT | Forschungsvereinigung Automobiltechnik AK 25 | Fügetechnik

2001: MCF V 1.0 (Ford)

2006: **χMCF V 1.0**

2011: **χMCF V 1.1**

2014: **χMCF V 2.0**

2015: **χMCF V 2.1**

2016: **χMCF V 3.0**

2020: **χMCF V 3.1**

Next AK 25 meeting: *2020-12-10* (online):

- Status of ISO standardization.
- Software vendor's reports
- Project backlog

… will be continued by:

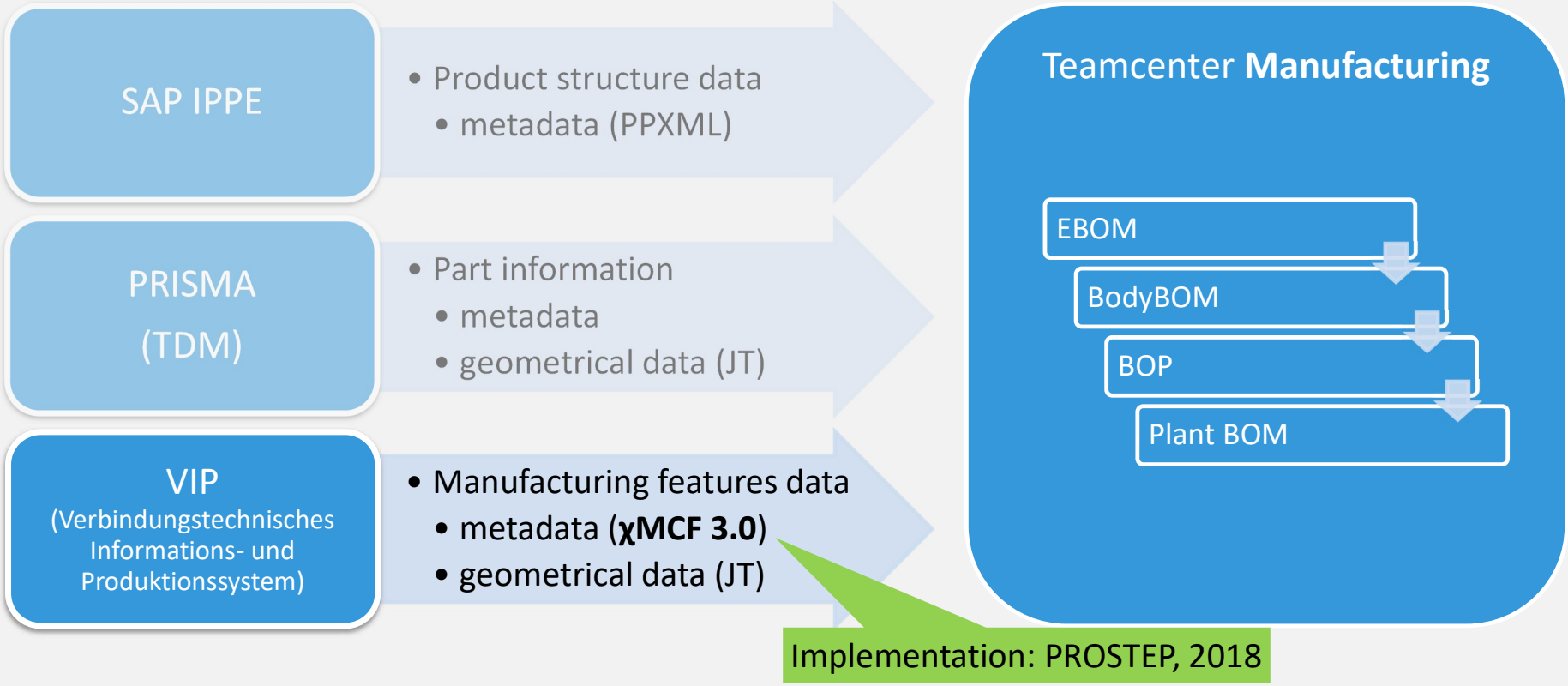
- Catalogs for standard parts
- New innovative techniques
- Even more examples
- …

Strategy & Example Use Cases at BMW

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

As of 2019

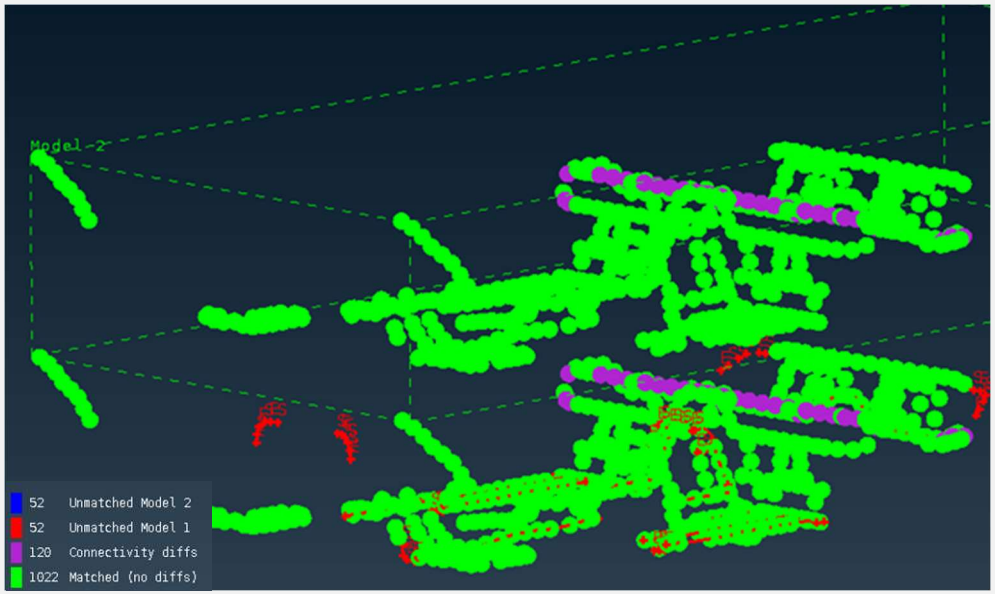
Use Case @ BMW: χMCF Data Exchange between PDM & **Production Planning**



BMW χMCF Strategy

- Production Planning (Teamcenter Manufacturing) has been addressed 2018 – supported by PROSTEP AG.
- 2019, CAE was addressed – supported by BETA CAE.
- Data for CAE contains technology parameters, e.g. weld shape.
- Other core business processes will follow.

FEM preprocessor acted as a *verification tool*, comparing VIP & χMCF data during prototype phase:

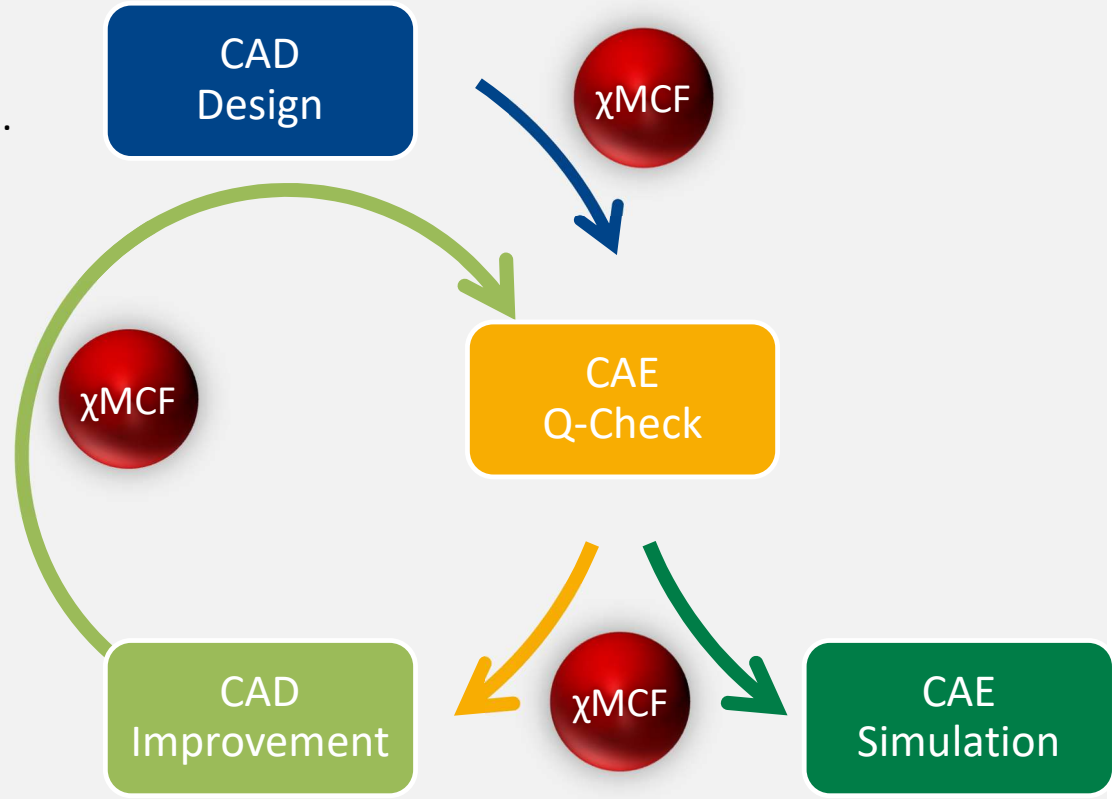


Example Use Case at Volkswagen

As of 2019

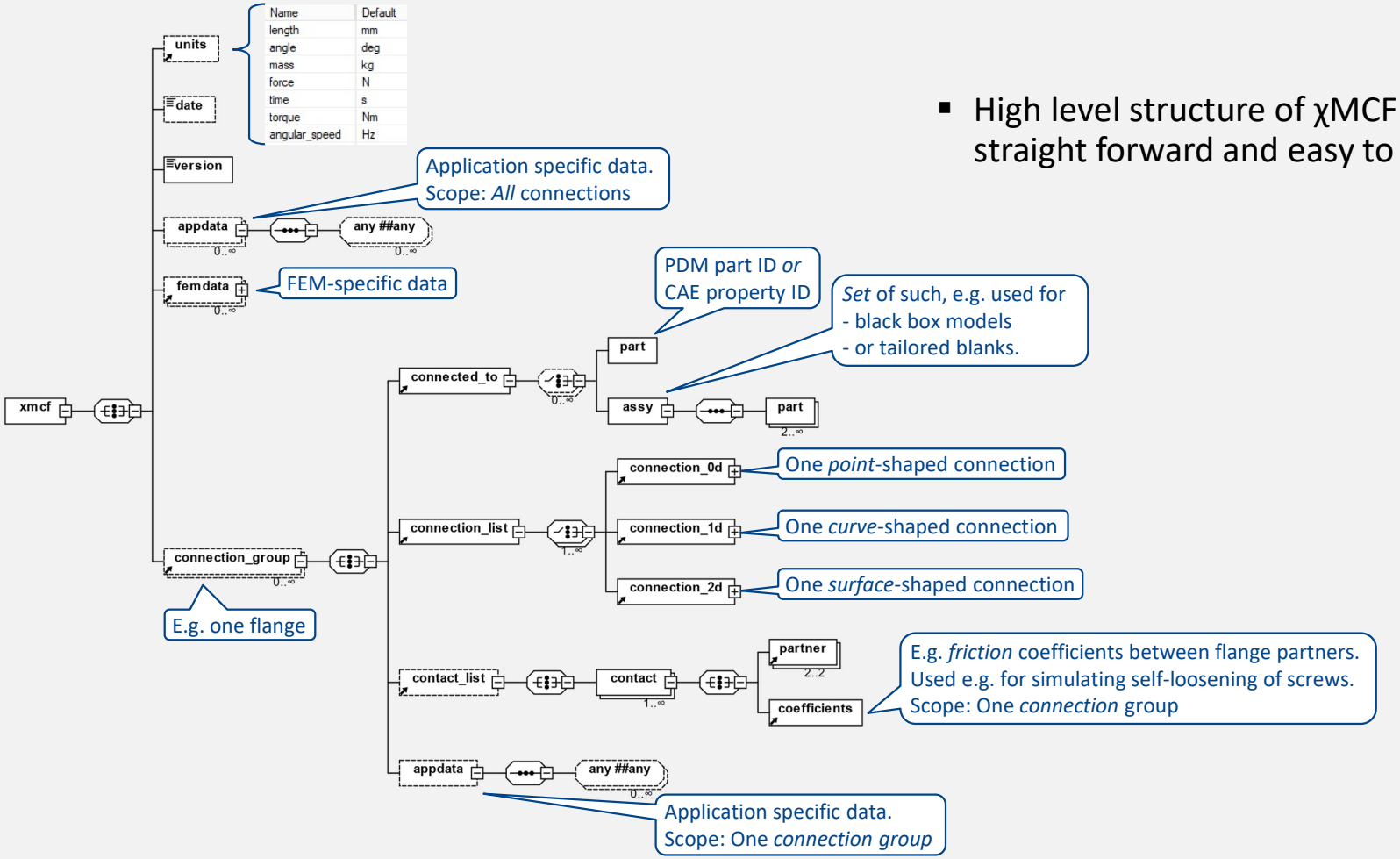
Use Case @ at Volkswagen:
Quality-Gate between CAD and CAE – Enabled by χMCF

- 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 FEM a preprocessor 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*.



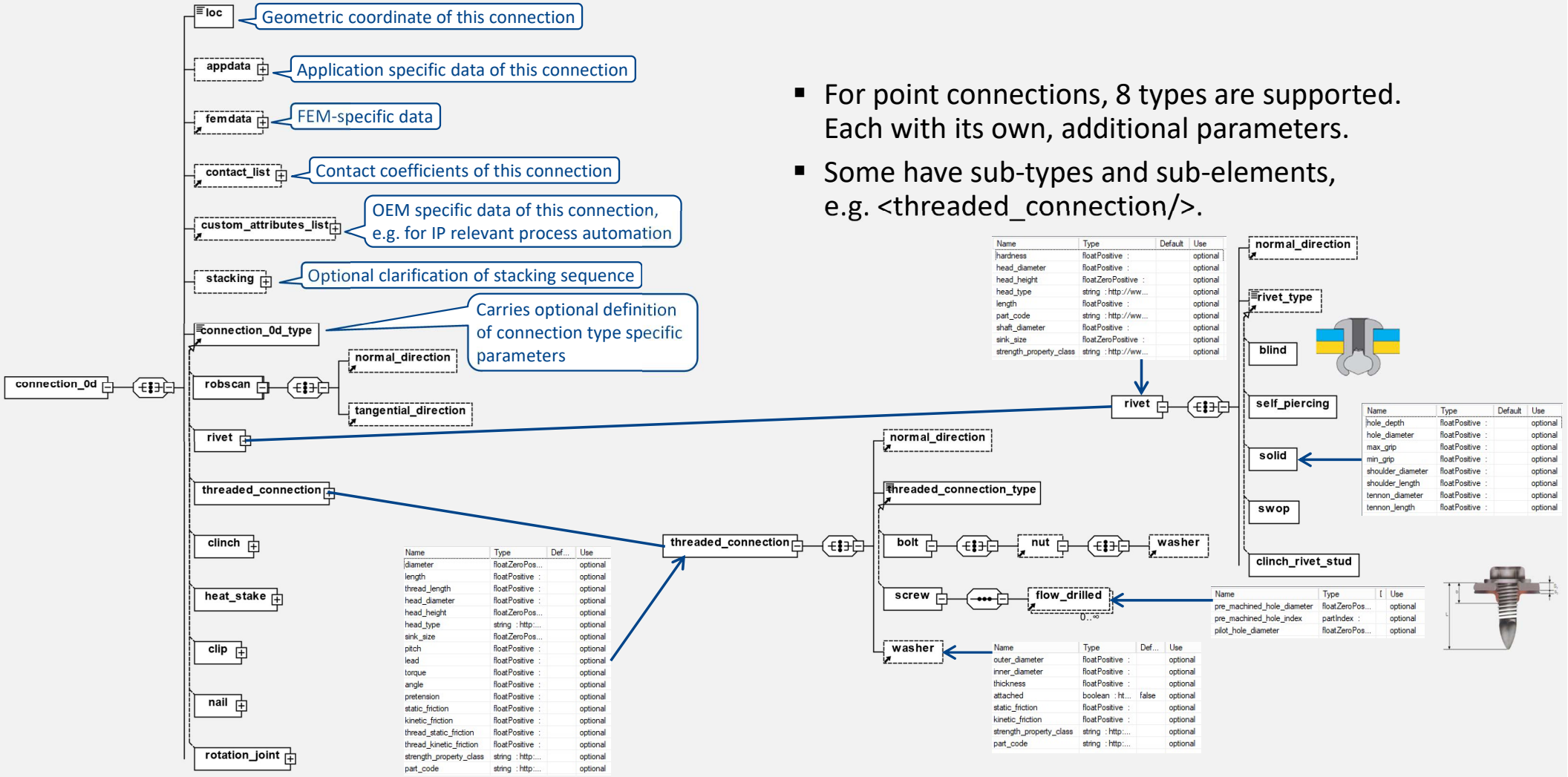
Technical Details

Structure of χMCF 3.1 XSD – High Level



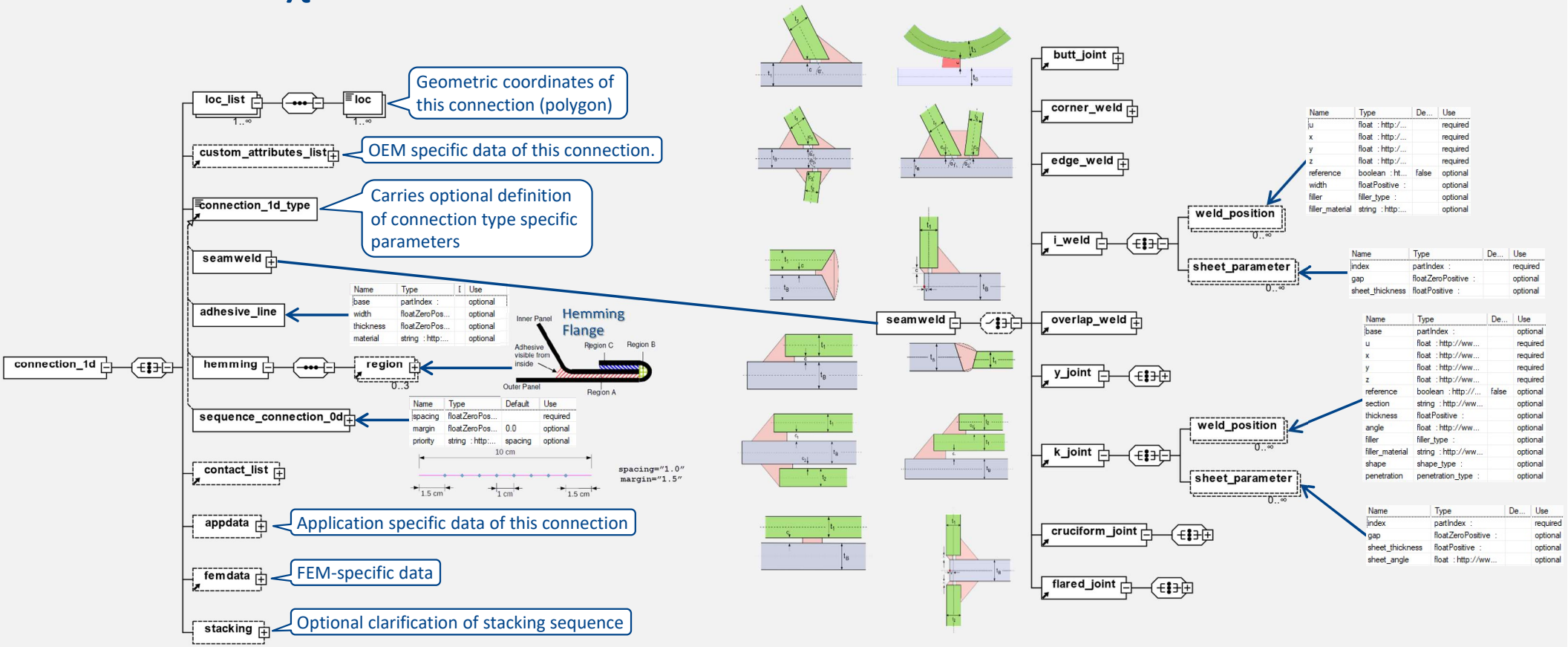
- High level structure of χMCF is straight forward and easy to understand.

Structure of χMCF 3.1 XSD – Point Connections

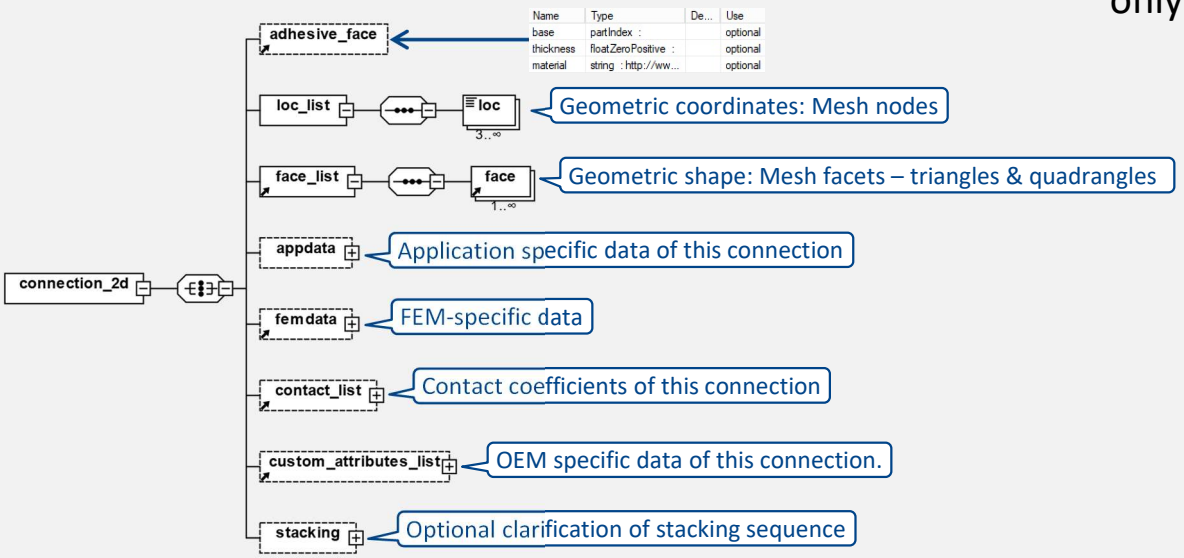


- For point connections, 8 types are supported. Each with its own, additional parameters.
- Some have sub-types and sub-elements, e.g. <threaded_connection/>.

Structure of χMCF 3.1 XSD – Curve Connections



Structure of χMCF 3.1 XSD – Surface Connections



- For surface connections,
  only one type is defined: adhesive gluing.

Summary

- Connection processes are *rich and manifold* – so are the data.
- χMCF 3.1 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 3.1 – more to come.

➔ AK 25 provides support when *optimizing processes to benefit* from χMCF 3.1.

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

Thank You!

PROSTEP AG
www.PROSTEP.com

Dr. Carsten Franke
Carsten.Franke@prostep.com – Mobile: +49 151 500 36868
Wankelstr. 14/II, 70563 Stuttgart, Germany
https://www.linkedin.com/in/diplmathdrcarstenfranke/

Roles in χMCF context:

- 2019-2020: χMCF 3.1 reviewer (on voluntary basis)
- 2015-2016: χMCF 3.0 editor (on voluntary basis)
- 2014-2015: χMCF 2.1 editor in chief
- 2012-2014: χMCF 1.2 & 2.0 editor
- Since 2005: Founding member of VDA FAT AK 25 χMCF working group.
- 2002-2015: Responsible for connection techniques as project manager at T-Systems's MEDINA team. (Finite element pre- & post-processor)
  Further responsibilities: CAD-interfaces (STEP, JT, IGES, ACIS, …)
  SDM, Assembly, Composites, Offshore sites Brazil & Russia, …