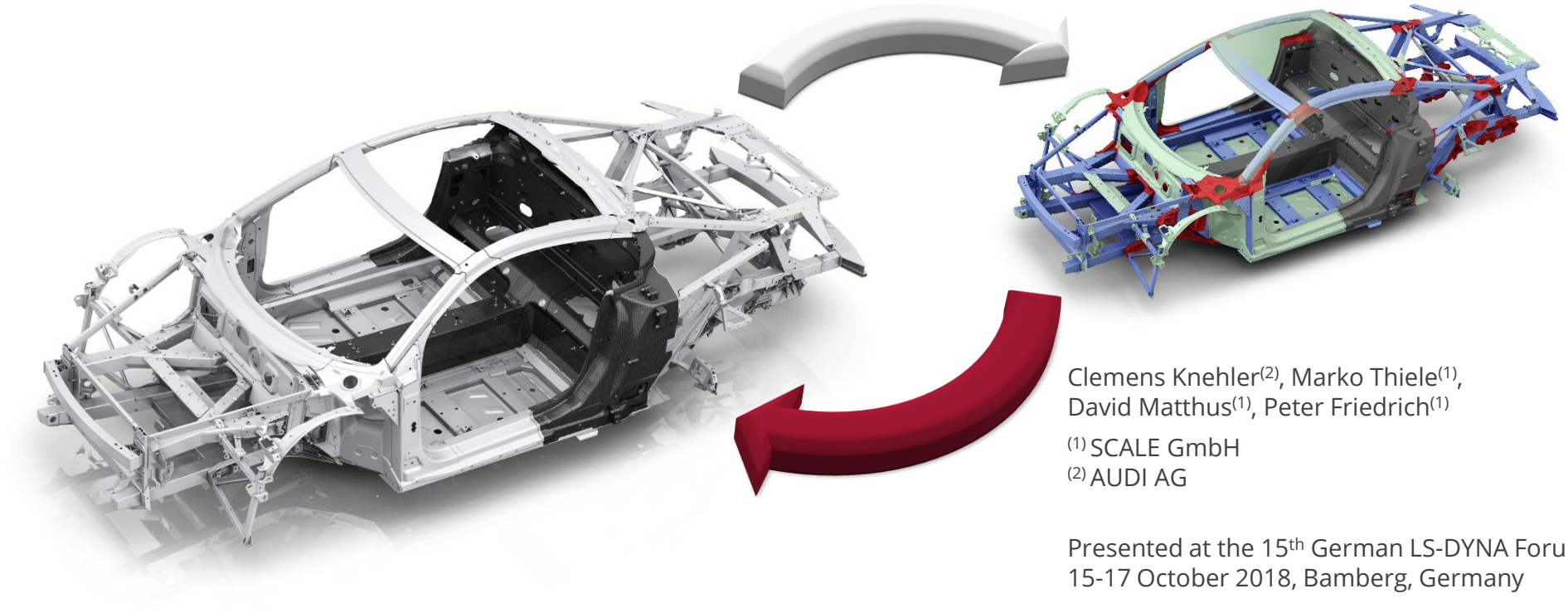
Prospects of integrating CAD and CAE in Simulation Data Management



Clemens Knehler[2], Marko Thiele[1],
David Matthus[1], Peter Friedrich[1]

[1] SCALE GmbH
[2] AUDI AG

Presented at the 15th German LS-DYNA Forum
15-17 October 2018, Bamberg, Germany

A general introduction to SCALE SDM products is part of our workshop tomorrow at 11:00 in this room.

Agenda

- **Integrating CAD and CAE**
- **Body18 “Proof of Concept” at AUDI**
- **Proposed Approach**
  - Data structure
  - Handling of connection information
- **Implementation of Body18 “Proof of Concept”**
  - Integration of CATIA for CAD and ANSA for CAE
  - Closing the gap between CAD and CAE
  - Crafting simulations for different solvers and disciplines on the same data
  - Project management
- **Roundup**
- **Outlook**

Agenda

Integrating CAD and CAE

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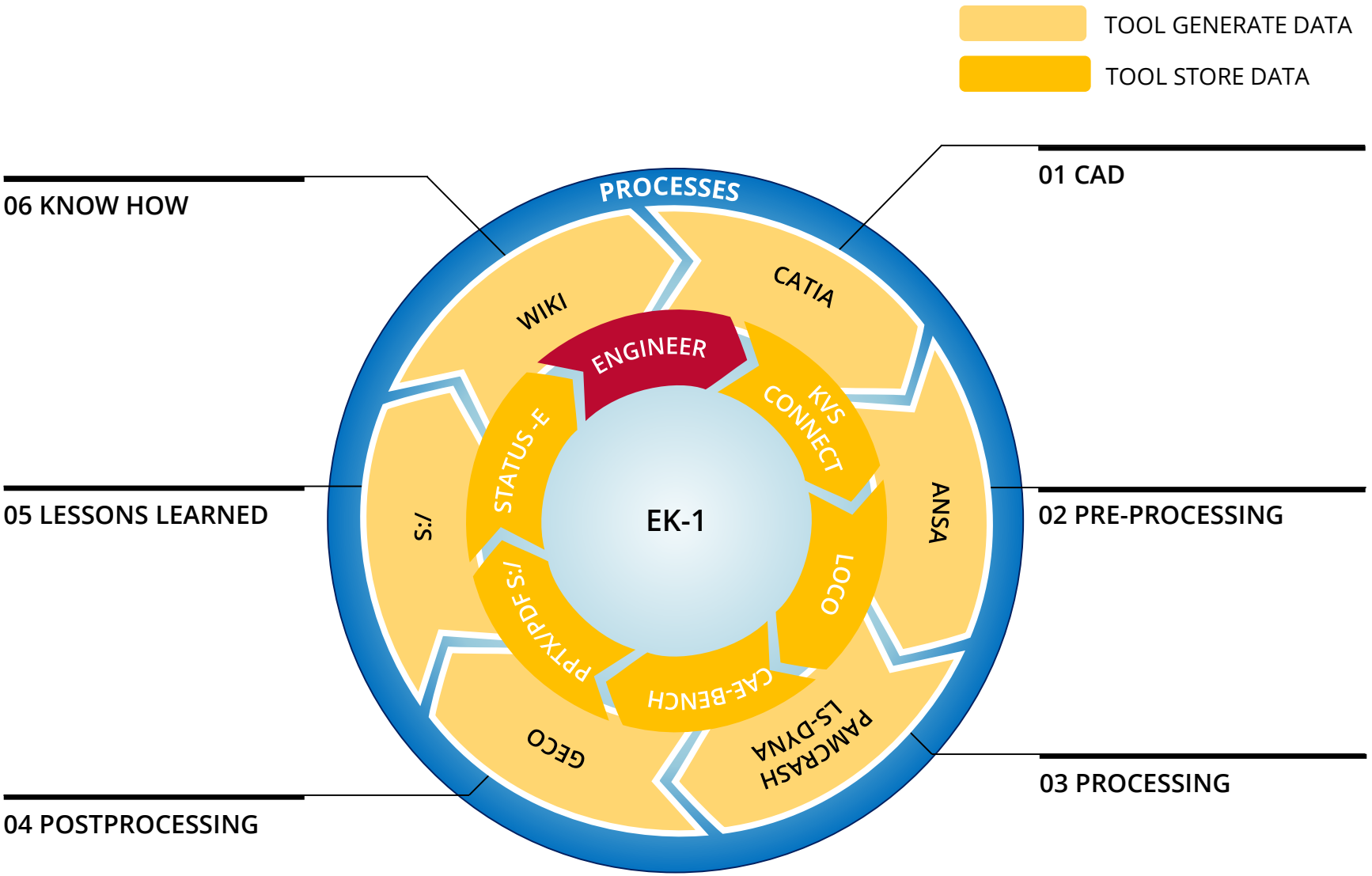
- Roundup
- Outlook

Integrating CAD and CAE - *motivation for Body18*



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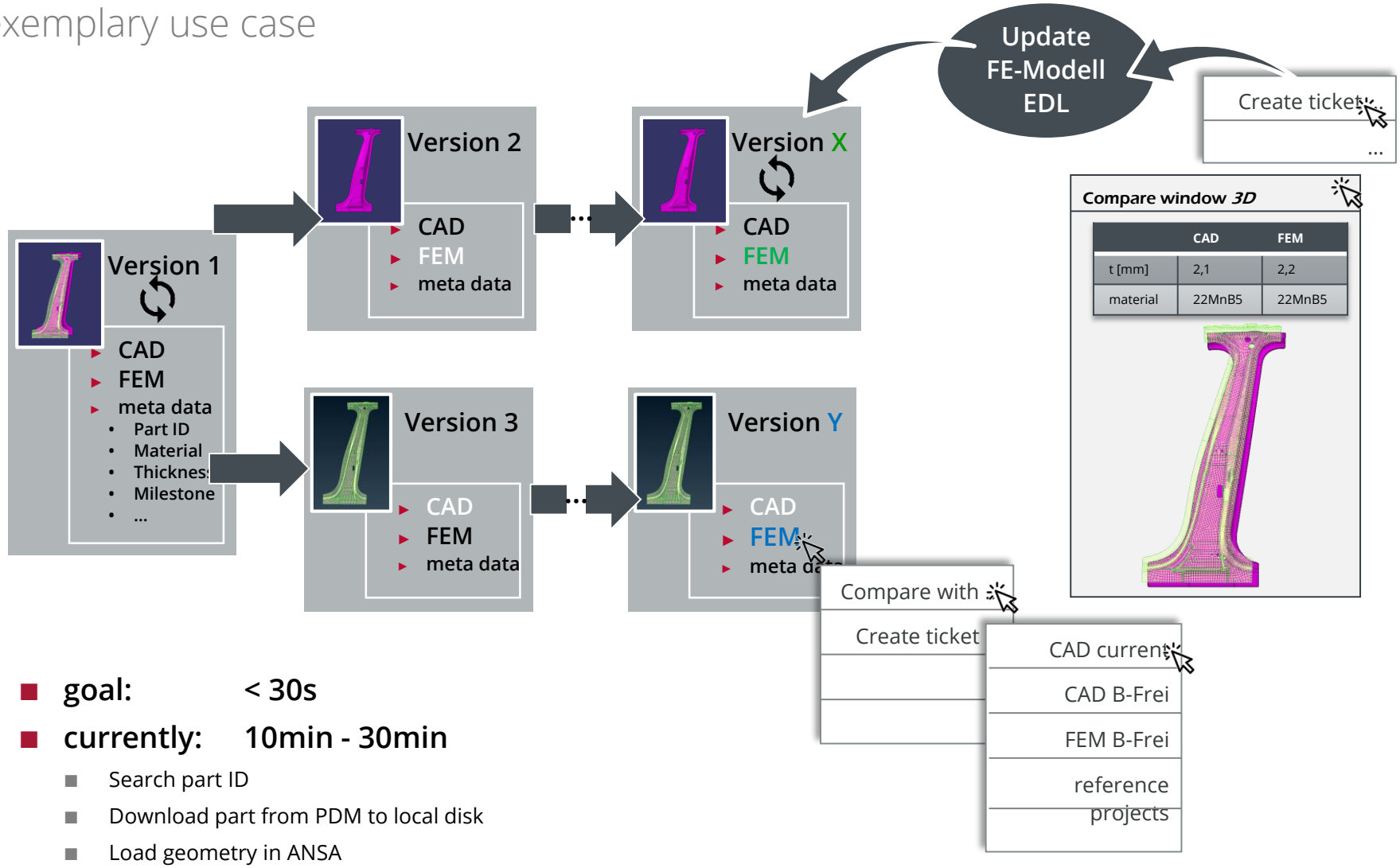
Integrating CAD and CAE - *motivation for Body18*

exemplary use case



- **goal:** < 30s
- **currently:** 10min - 30min
  - Search part ID
  - Download part from PDM to local disk
  - Load geometry in ANSA
  - Lookup CAD attributes in CATIA or some Excel sheet
  - Write E-Mail or call engineering service supplier to assign next task
  - Send data to engineering service supplier through data exchange platform

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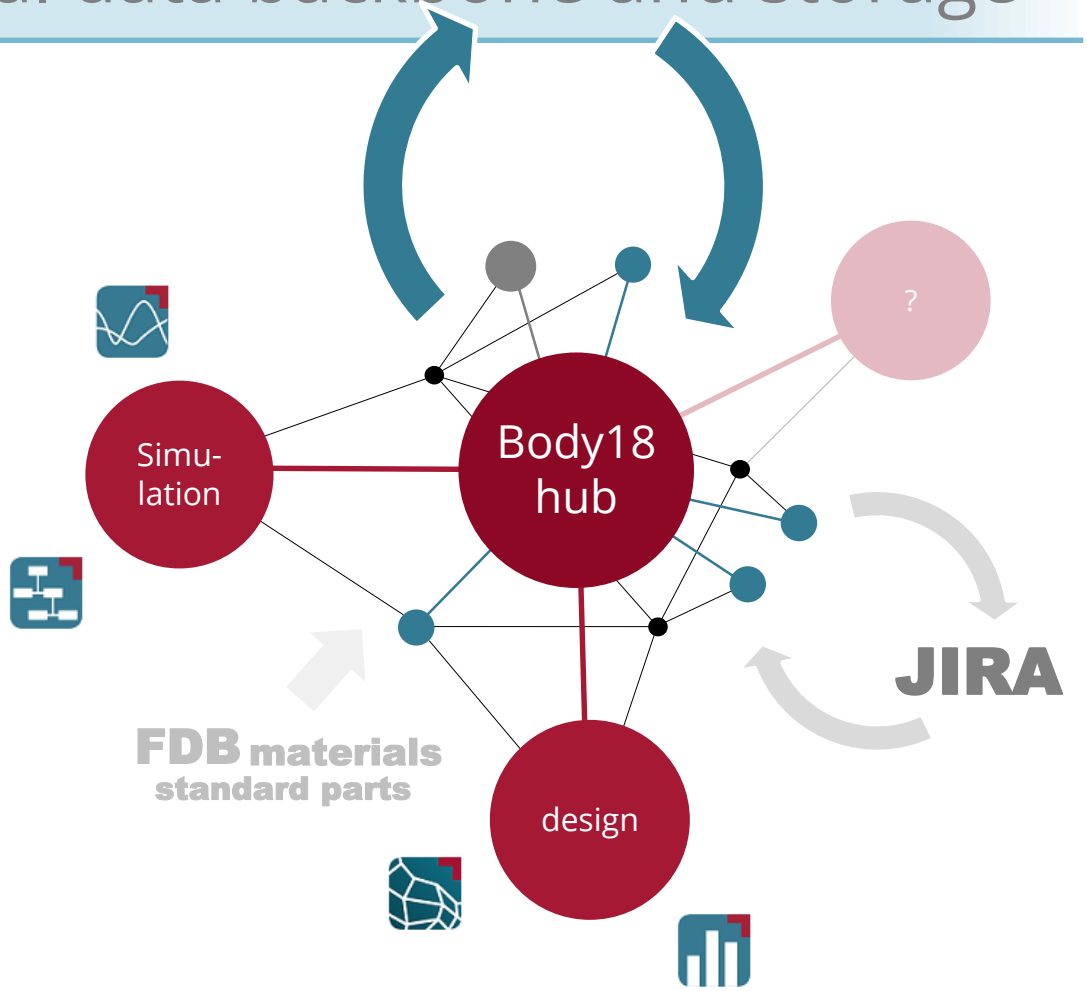
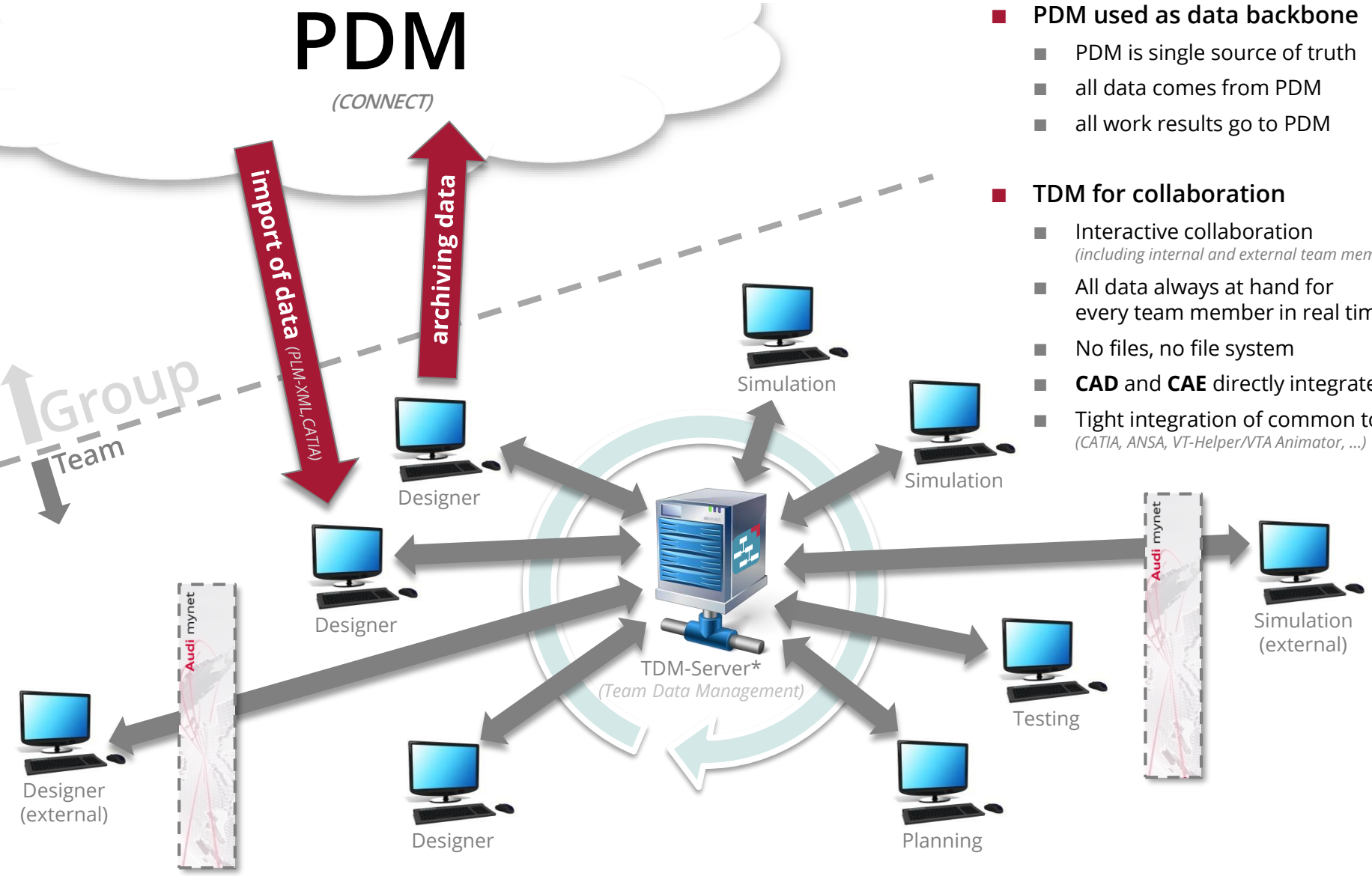
Body18 “Proof of Concept” at AUDI - *goals*

PDM / CONNECT
central data backbone and storage

- **Supplement existing PDM with team collaboration**
- **Focus**
  - Instant collaboration
  - Integrate CAD and CAE apps
  - Seamless data integration between CAD and CAE
  - Integration of project management system *(JIRA)*
- **Create common platform to integrate further apps**



Body18 “Proof of Concept” at AUDI - *setup*



- **PDM used as data backbone**
  - PDM is single source of truth
  - all data comes from PDM
  - all work results go to PDM
- **TDM for collaboration**
  - Interactive collaboration
    (including internal and external team members)
  - All data always at hand for every team member in real time
  - No files, no file system
  - **CAD** and **CAE** directly integrated
  - Tight integration of common tools
    (CATIA, ANSA, VT-Helper/VTA Animator, ...)

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*The Body18 “Proof of Concept” at AUDI has been set up using an existing LoCo-Server installation

Agenda

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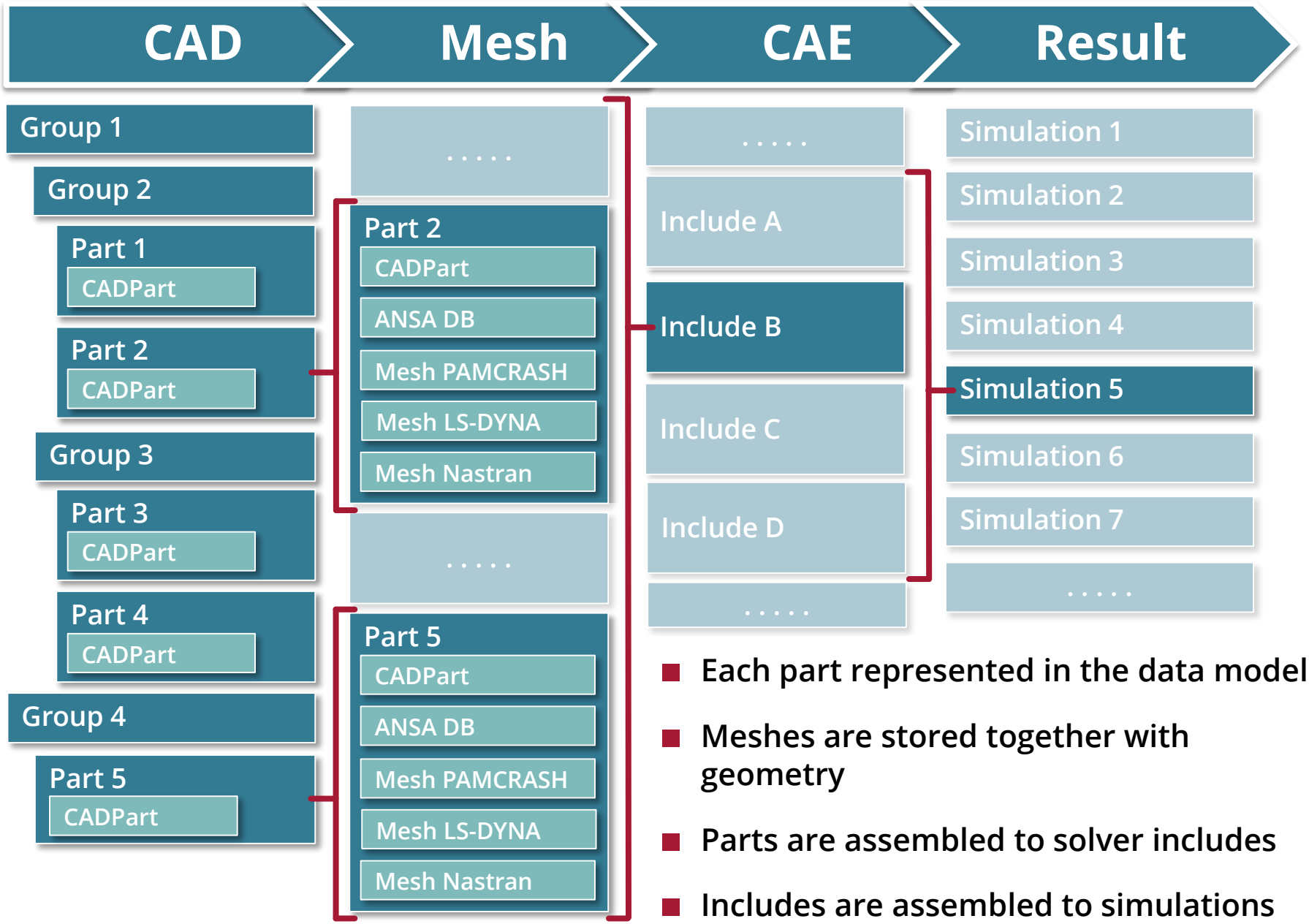
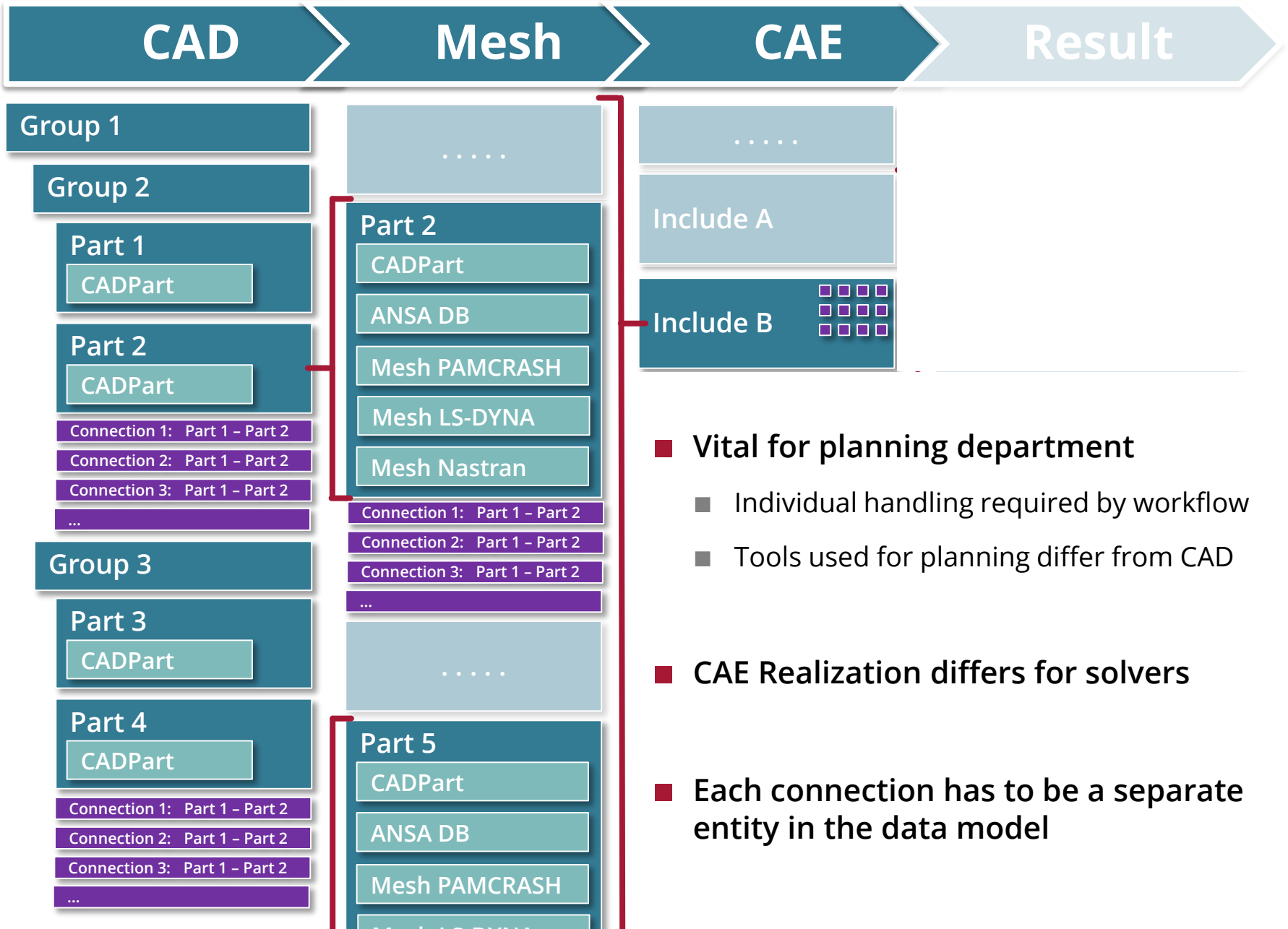
Proposed Approach - *data model*



- Each part represented in the data model
- Meshes are stored together with geometry
- Parts are assembled to solver includes
- Includes are assembled to simulations

Proposed Approach - *connection information*



- **Vital for planning department**
  - Individual handling required by workflow
  - Tools used for planning differ from CAD
- **CAE Realization differs for solvers**
- **Each connection has to be a separate entity in the data model**

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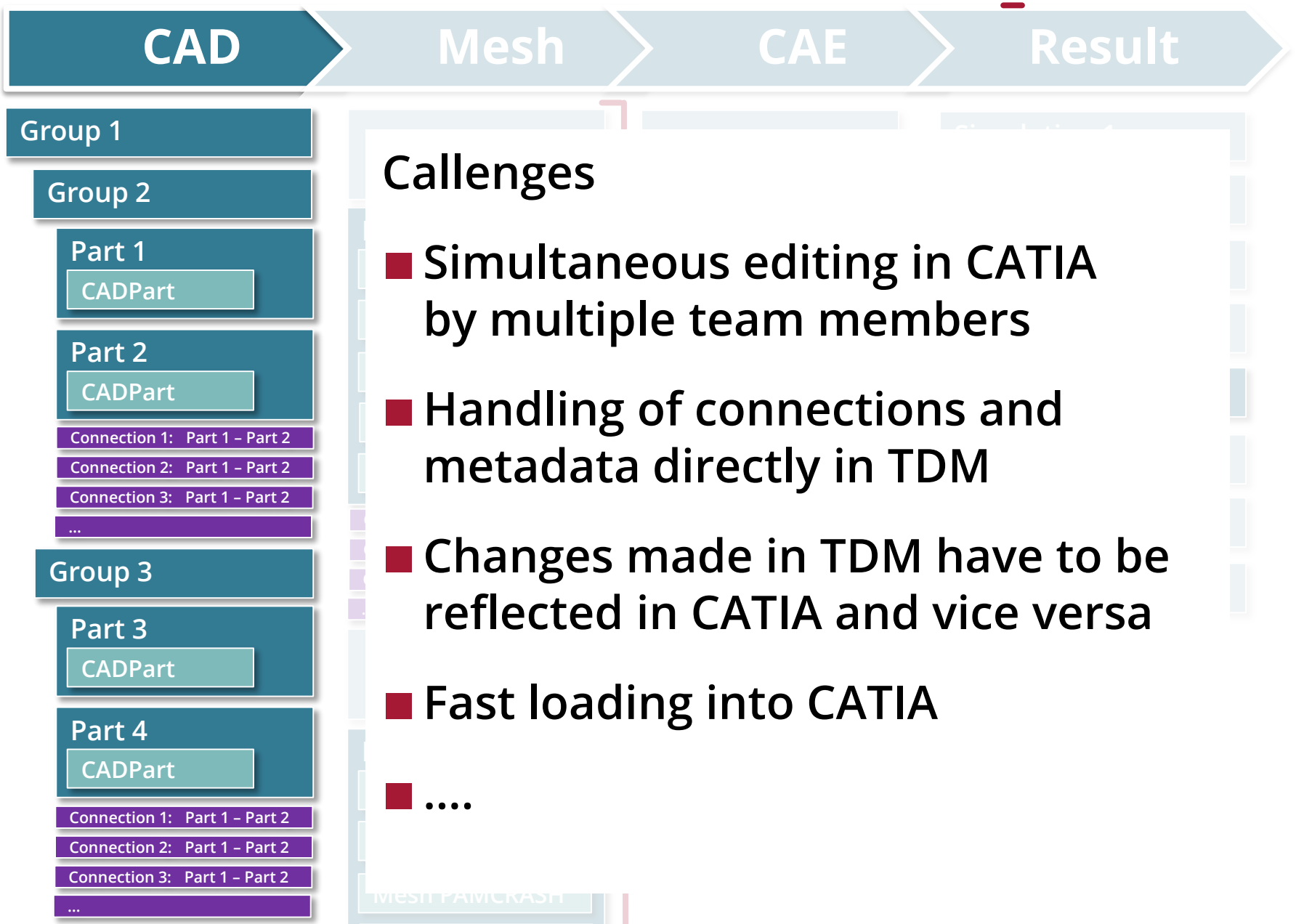
Implementation - *CATIA*



Callenges

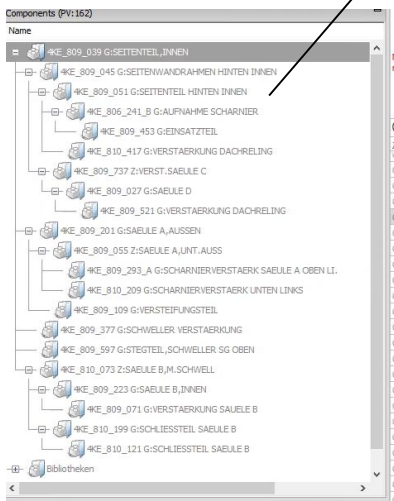
- Simultaneous editing in CATIA by multiple team members
- Handling of connections and metadata directly in TDM
- Changes made in TDM have to be reflected in CATIA and vice versa
- Fast loading into CATIA
- ....

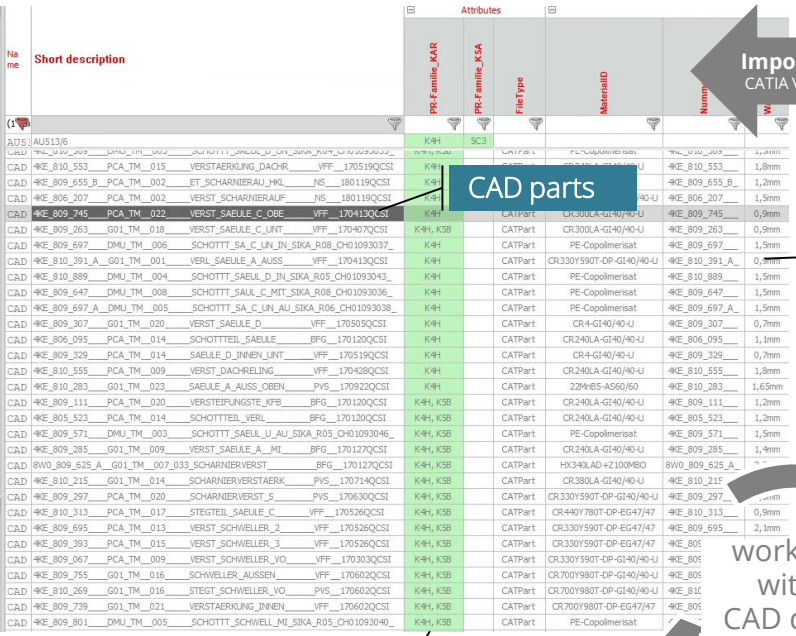
Implementation - *CATIA*

CAD | Mesh | CAE | Result

product structure from CATIA

Body18

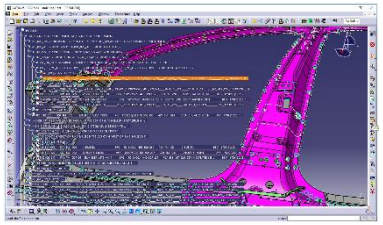




Import CATIA V5

CAD parts

CATIA V5

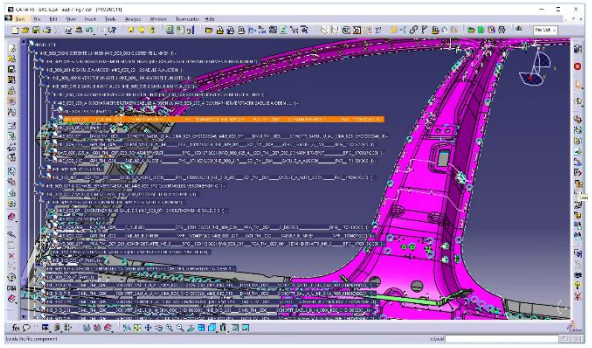


PDM System *(CONNECT)*

CAD meta data

working with CAD data

CATIA V5



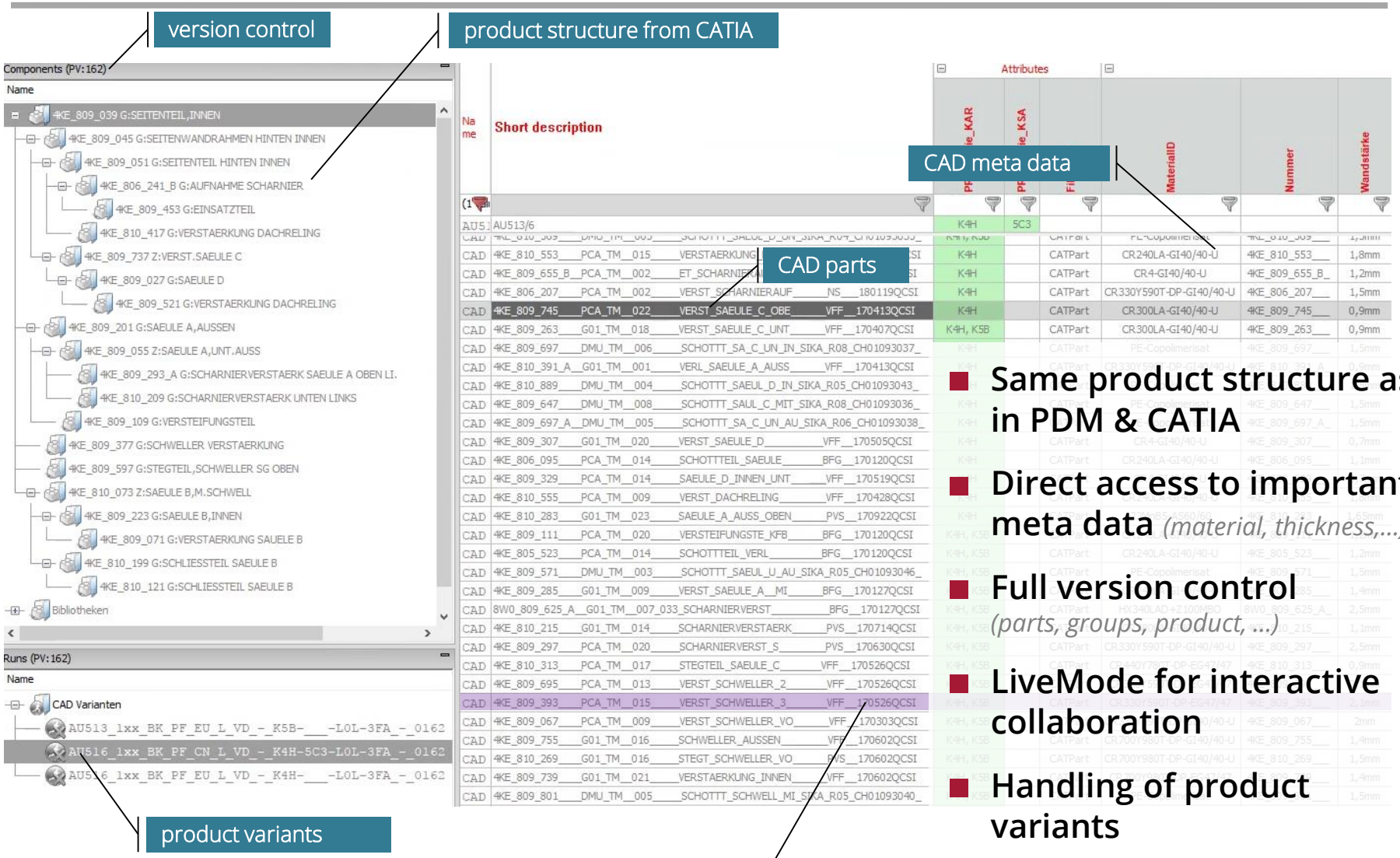
product variants

control of variants

Audi

Implementation - *handling CAD data*

CAD | Mesh | CAE | Result



- **Same product structure as in PDM & CATIA**
- **Direct access to important meta data** *(material, thickness,...)*
- **Full version control** *(parts, groups, product, ...)*
- **LiveMode for interactive collaboration**
- **Handling of product variants**
- **Representation of**
  - Geometric data
  - Connections

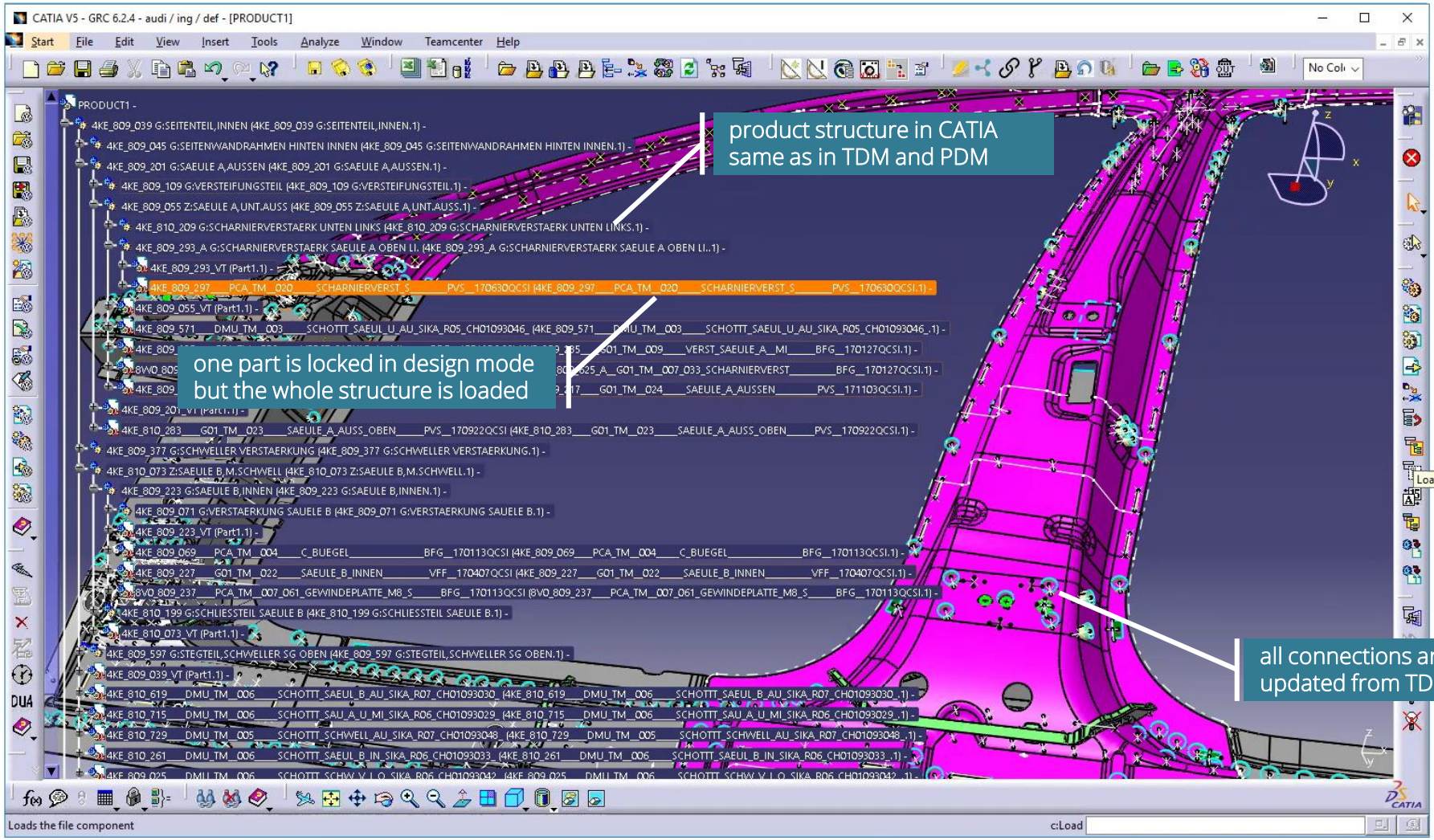
Audi

Implementation - *CATIA*

CAD | Mesh | CAE | Result

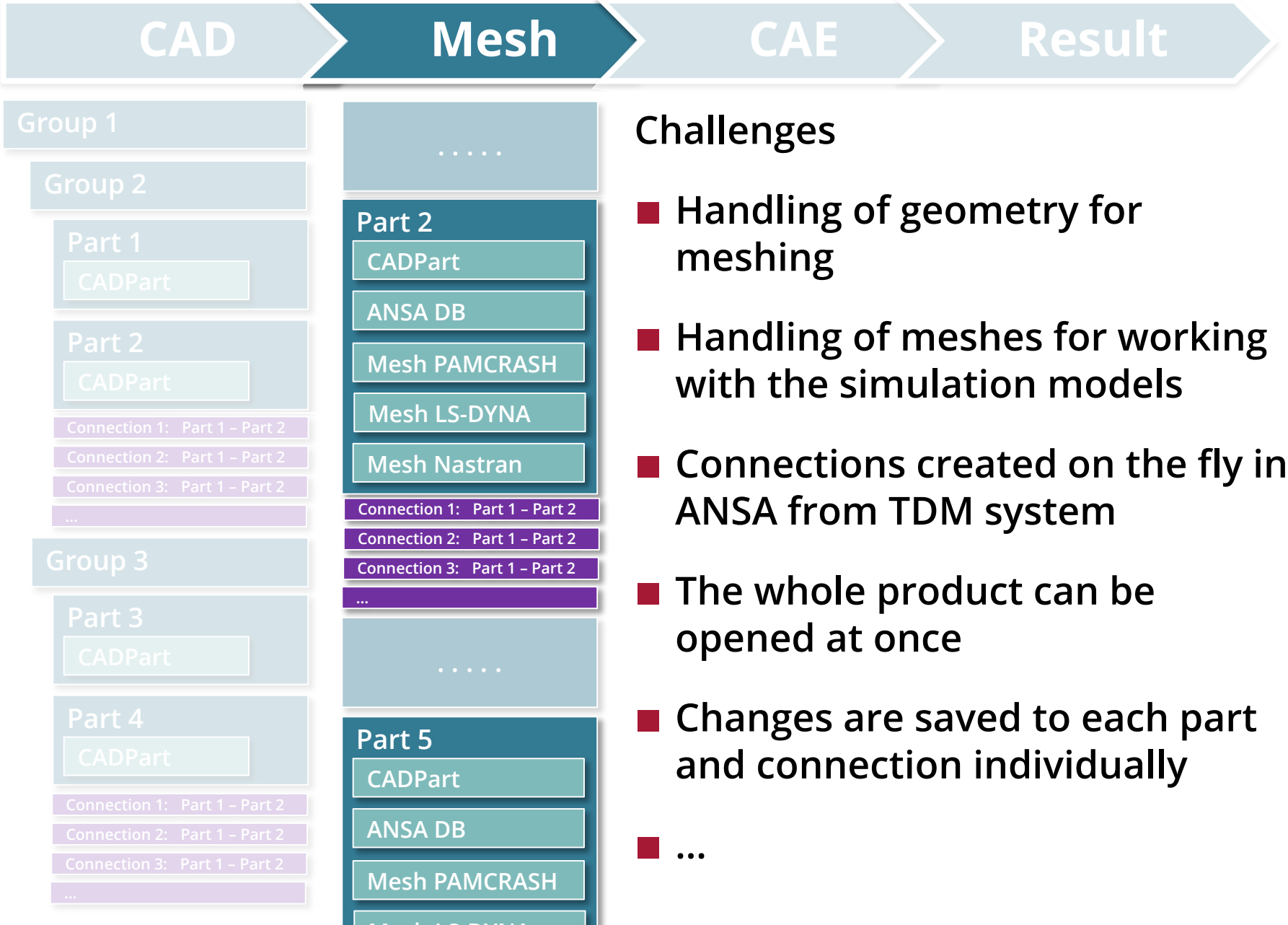
CATIA V5*

*the CATIA V5 integration for the “Body18” has been implemented by csi Entwicklungstechnik GmbH



Audi

Implementation - *ANSA*



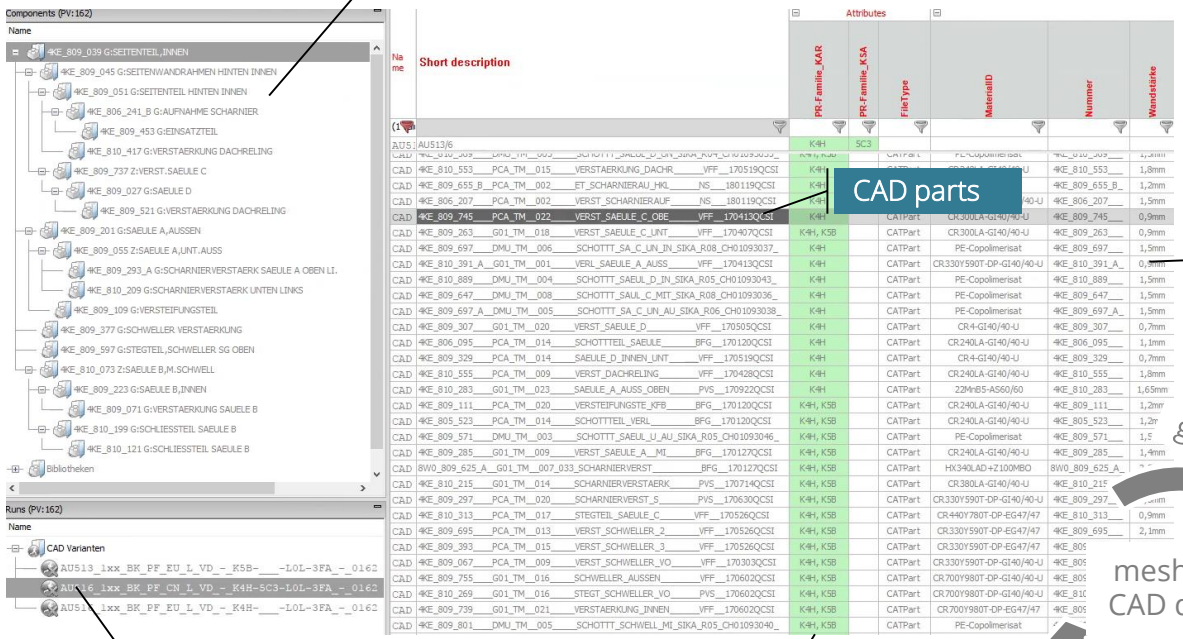
Challenges

- Handling of geometry for meshing
- Handling of meshes for working with the simulation models
- Connections created on the fly in ANSA from TDM system
- The whole product can be opened at once
- Changes are saved to each part and connection individually
- ...

Implementation - *ANSA*

product structure from CATIA

Body18



CAD parts

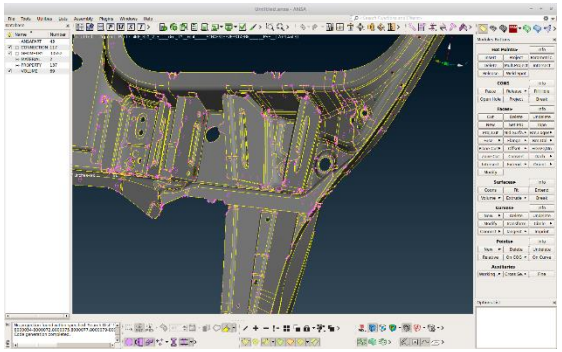
CAD meta data

geometry

meshing
CAD data

mesh

ANSA



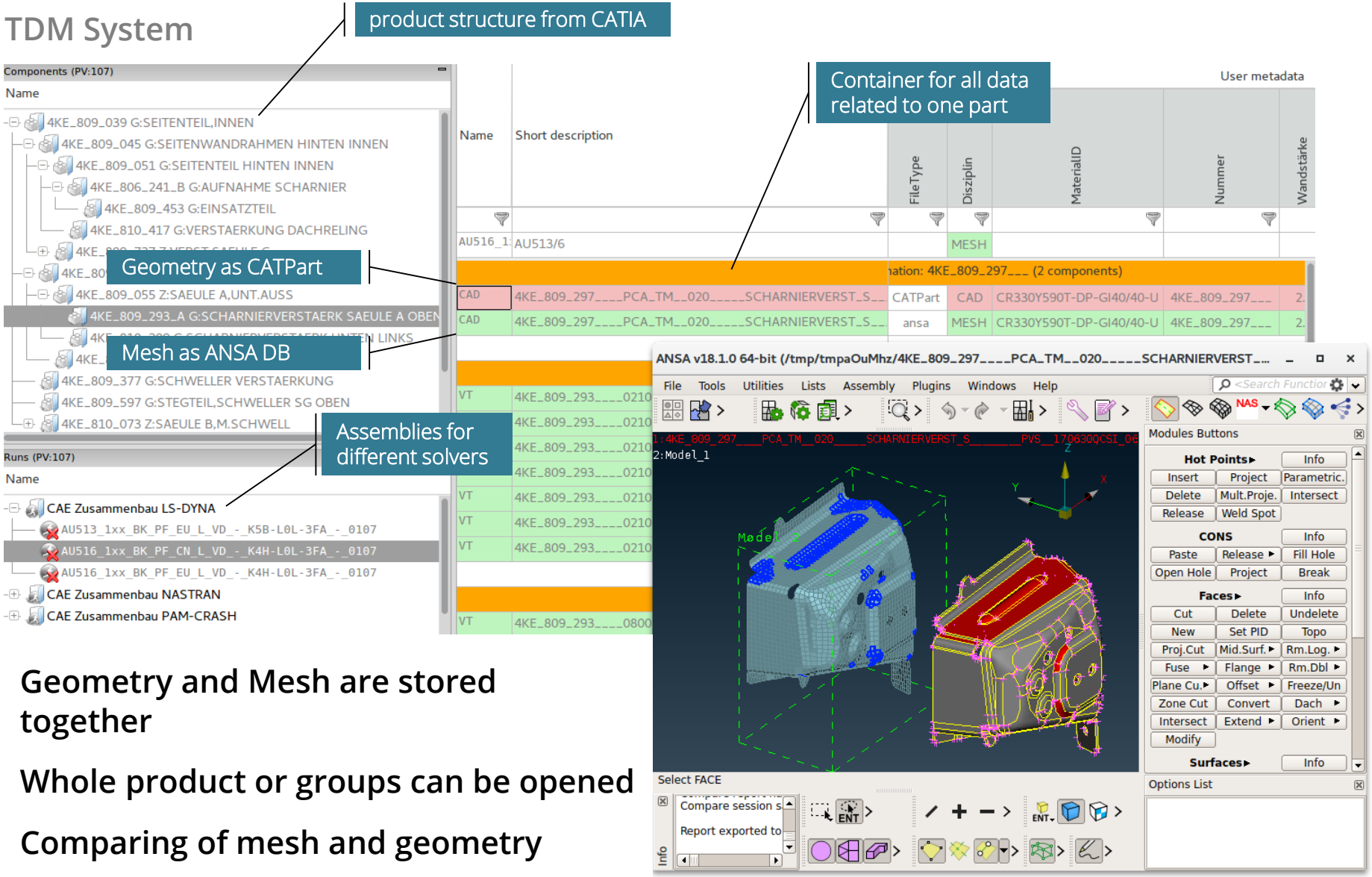
product variants

control of variants

Audi

Implementation - *ANSA*

TDM System

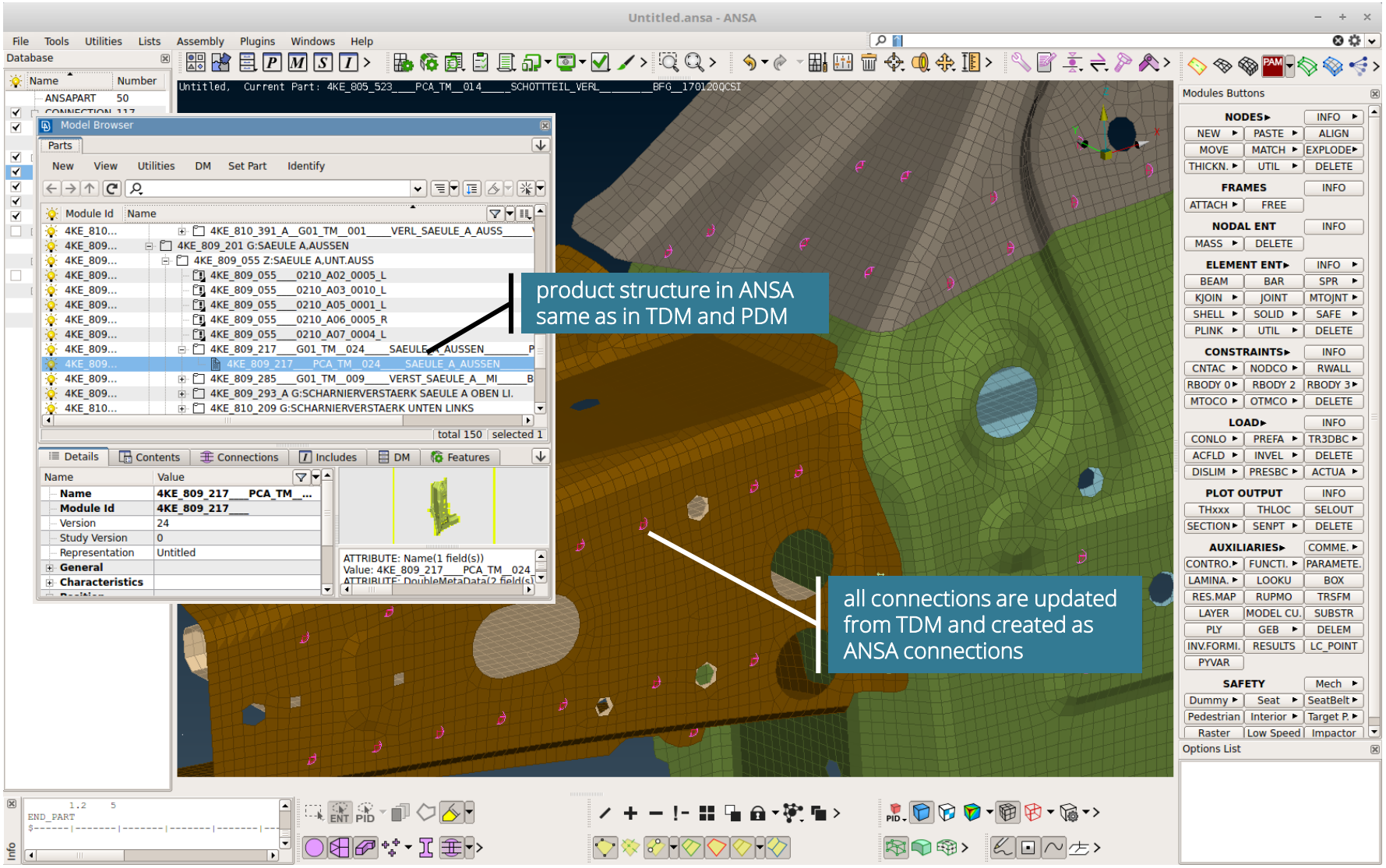


- Geometry and Mesh are stored together
- Whole product or groups can be opened
- Comparing of mesh and geometry
- Assemblies can create includes for multiple solvers

Implementation - *ANSA*

CAD | **Mesh** | CAE | Result

ANSA



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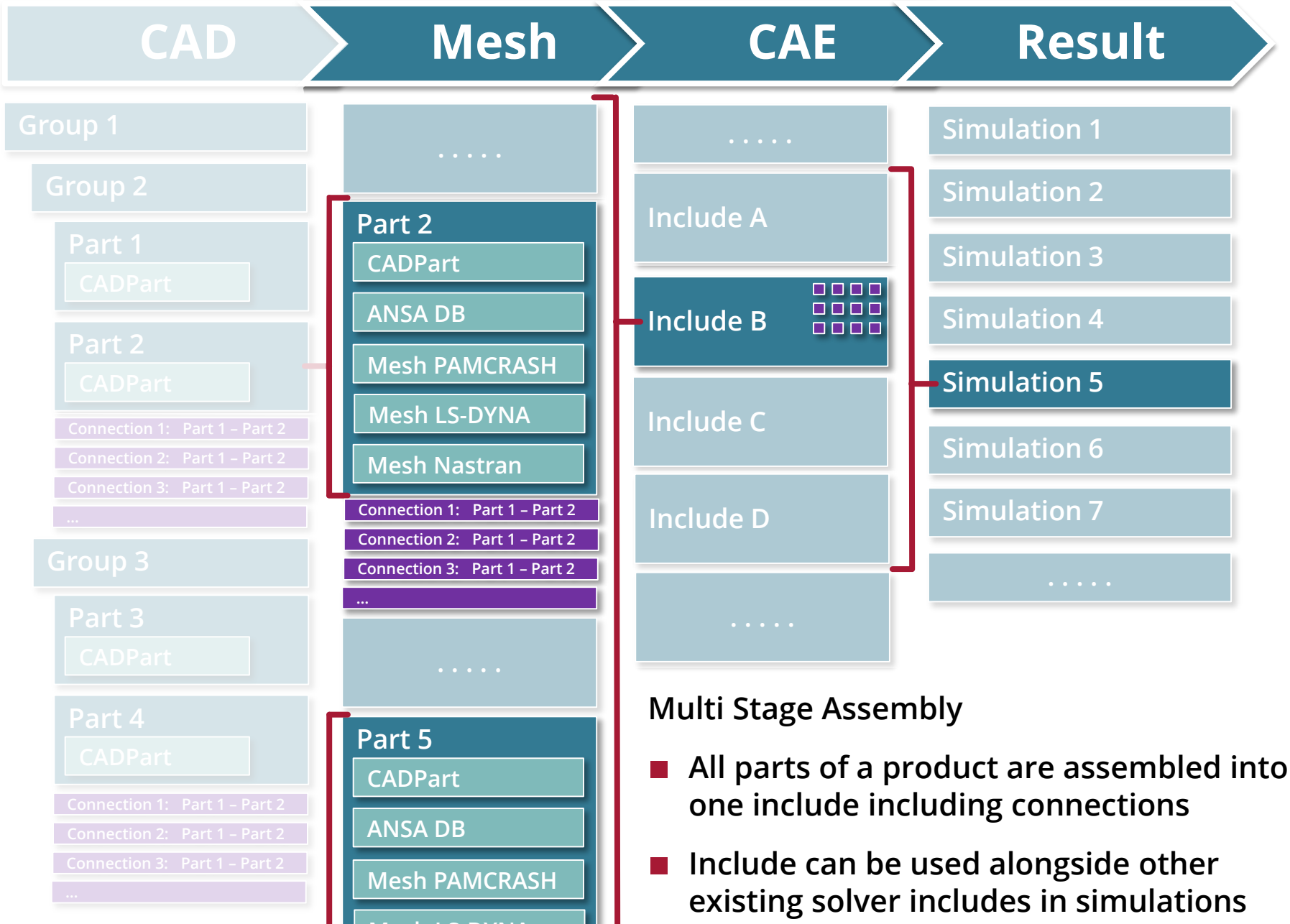
Implementation - *closing the gap to CAE*



Multi Stage Assembly

- All parts of a product are assembled into one include including connections
- Include can be used alongside other existing solver includes in simulations

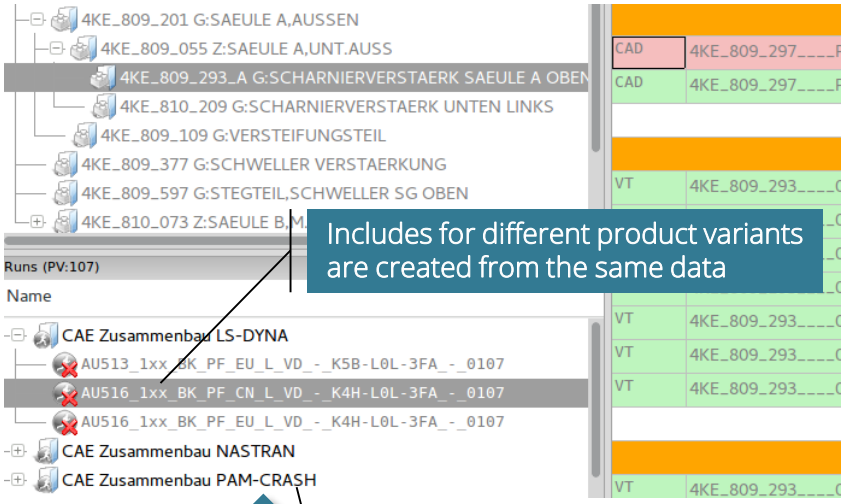
Implementation - *closing the gap to CAE*

CAD | Mesh | CAE | Result

The result of the assembled CAD data *(RunOutputComponent)* is used as a solver include in simulations.

The solver include is directly linked to the CAD assembly and gets updated if CAD data changes.

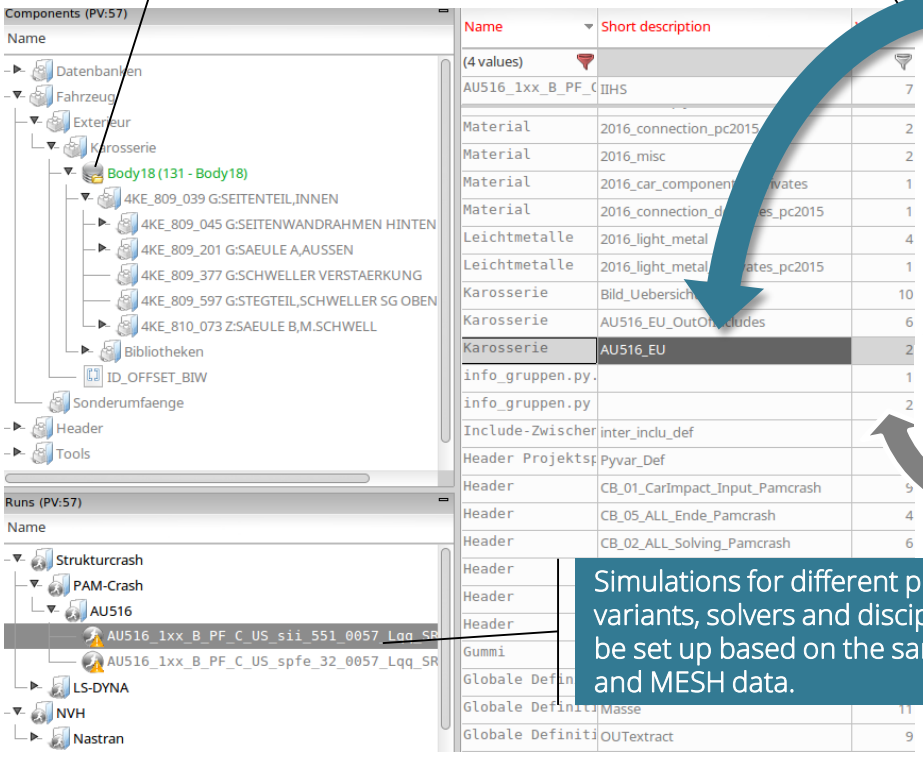
CAD



Includes for different product variants are created from the same data

CAE

CAD body in white pool mounted in simulation pool

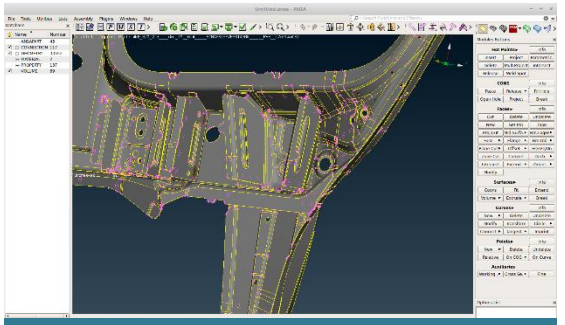


working on the simulation model

Simulations for different product variants, solvers and disciplines can be set up based on the same CAD and MESH data.

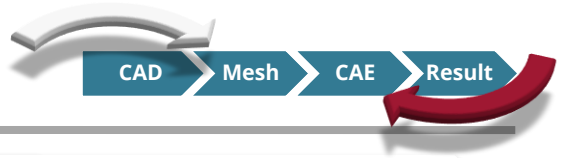
ANSA

Assemblies for different solvers create as result solver include files. ANSA is used in batch to create the includes and connections are realized according to the needs of the simulation.



Working with simulation models in ANSA occurs on same meshes and CAD data

Implementation - *project management*



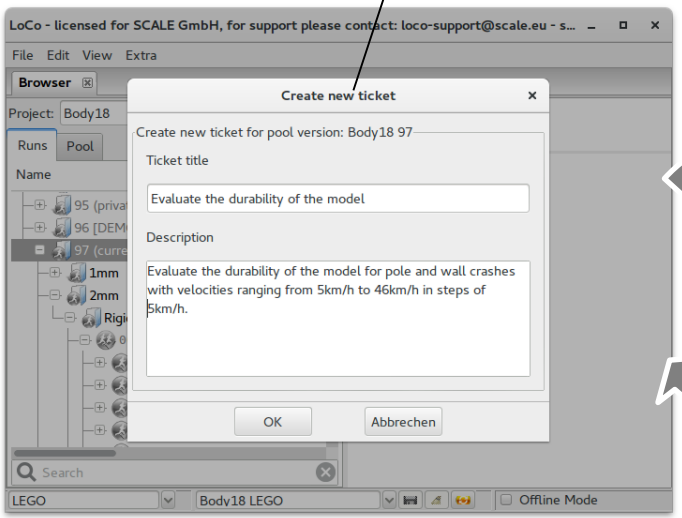
CAD → Mesh → CAE → Result

- Notifications
- Requests
- Tasks

Implementation - *project management*

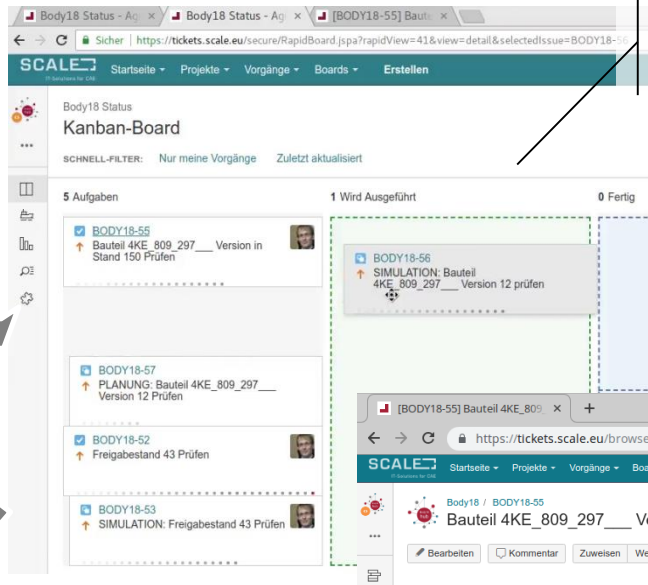
CAD → Mesh → CAE → Result

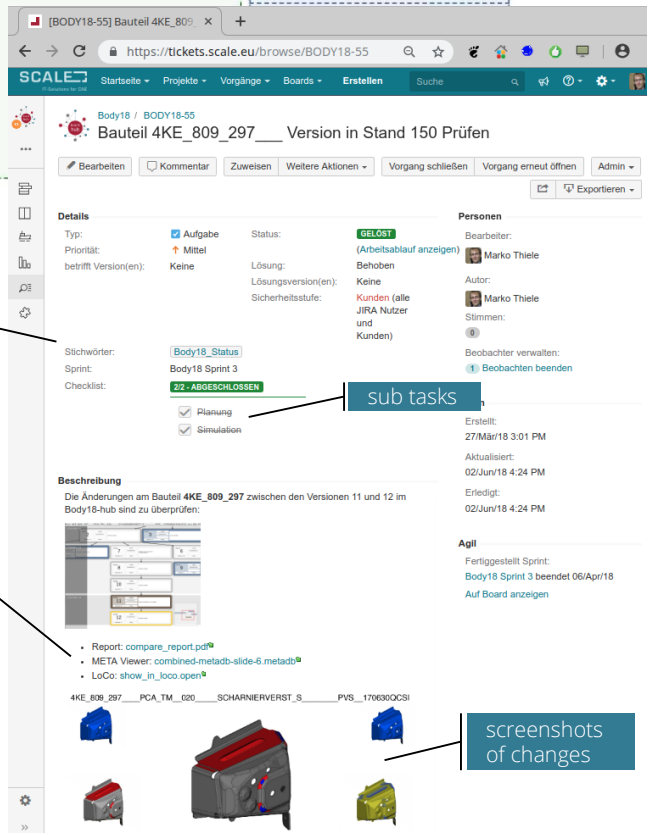
Tasks are created directly with the desktop clients



Integration with project management system

Kanban-Board for easy task management





detailed task description with automatically created contend

sub tasks

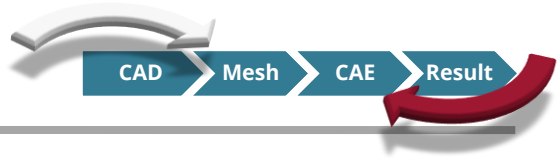
links to related documents

screenshots of changes

- Integration of in house project management system
- Full capabilities of commercial project management systems
- Tasks are directly linked to CAD/CAE data
- All communication related to a task is documented

JIRA OpenProject

Roundup



- **Simultaneous working with CAD data in CATIA**
- **Geometry and meshes handled as one object** *(part)*
- **Seamless transition between CAD and CAE**
- **Using the same Geometry and Meshes for**
  - Multiple product variants
  - Simulating with different solvers
  - Load cases in different disciplines
- **Integration of project management tools**

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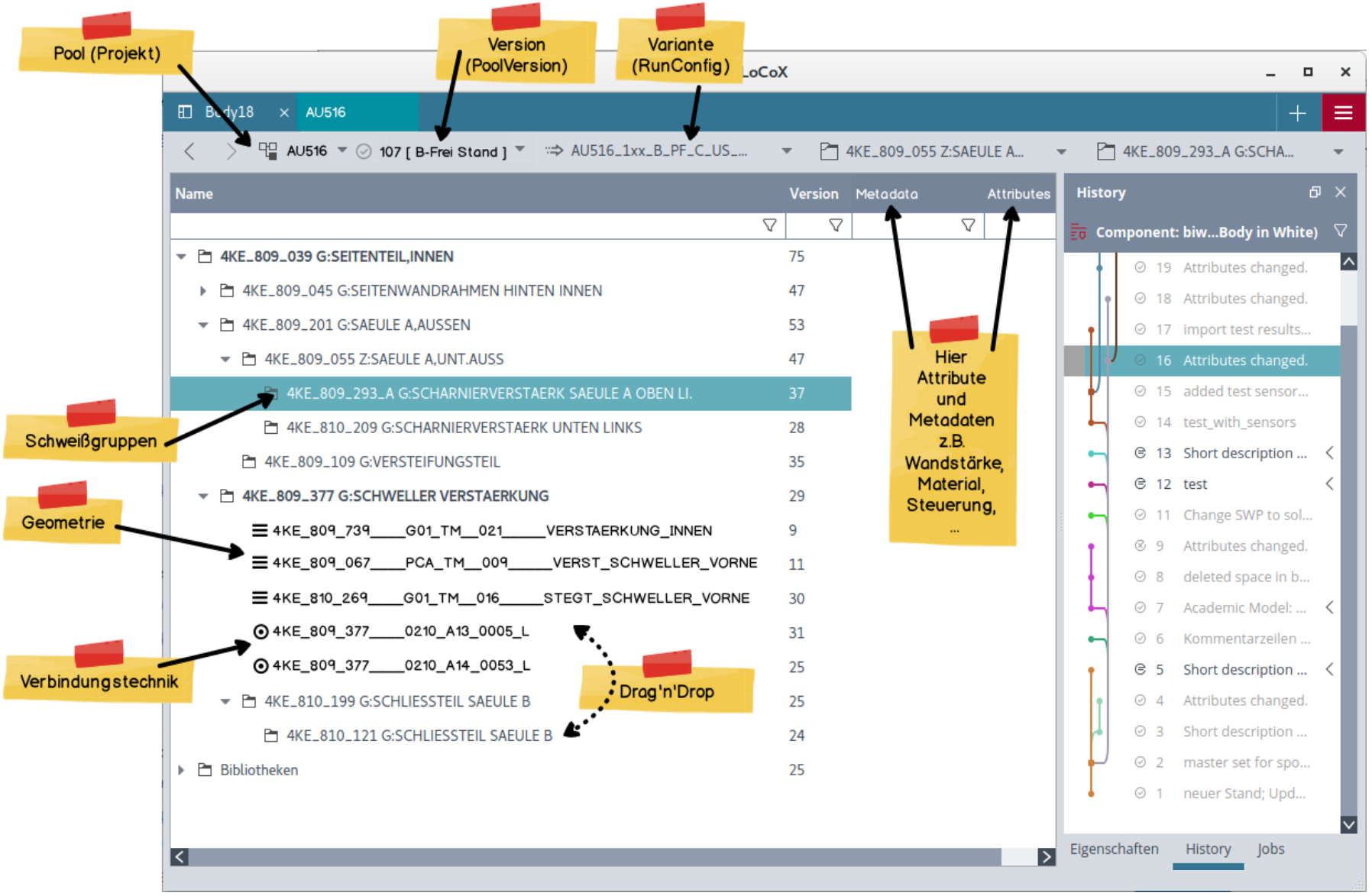
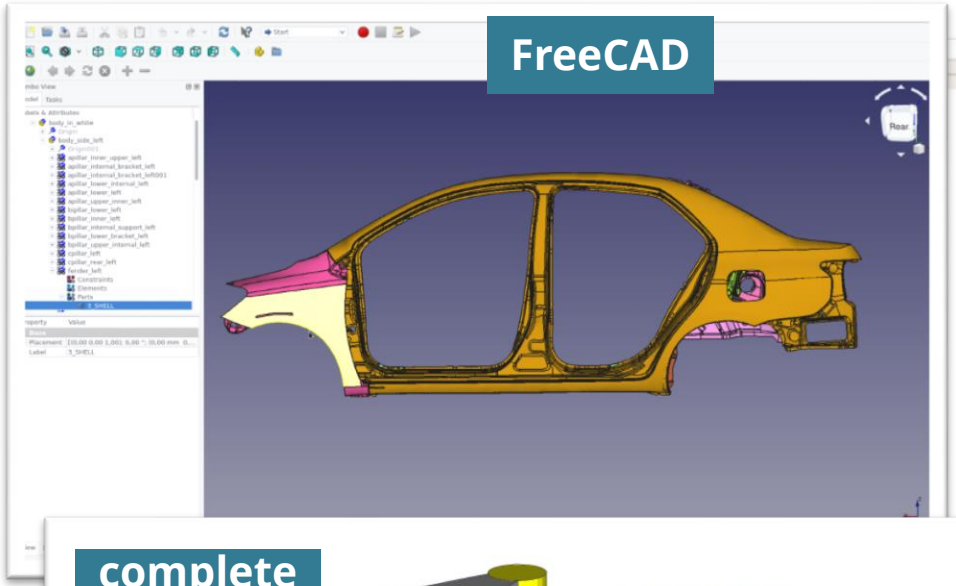
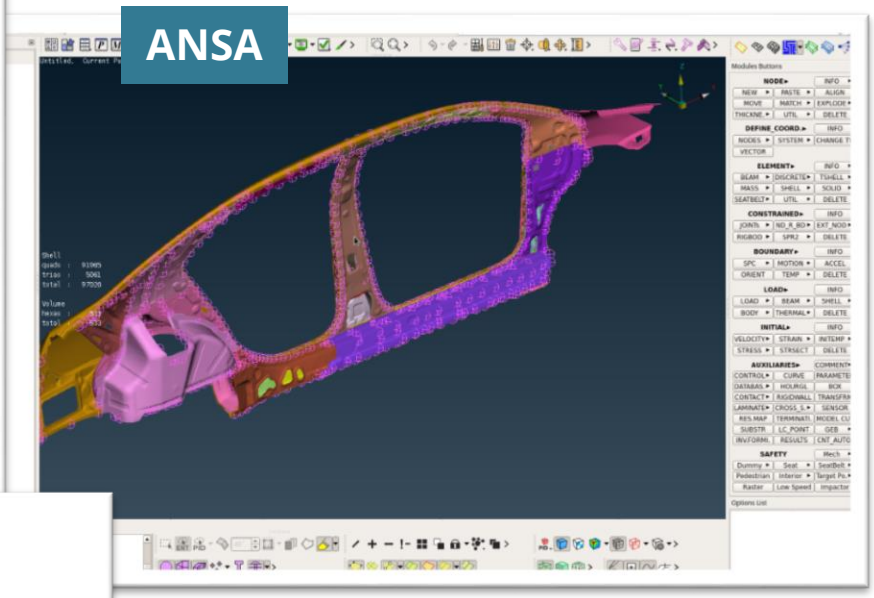
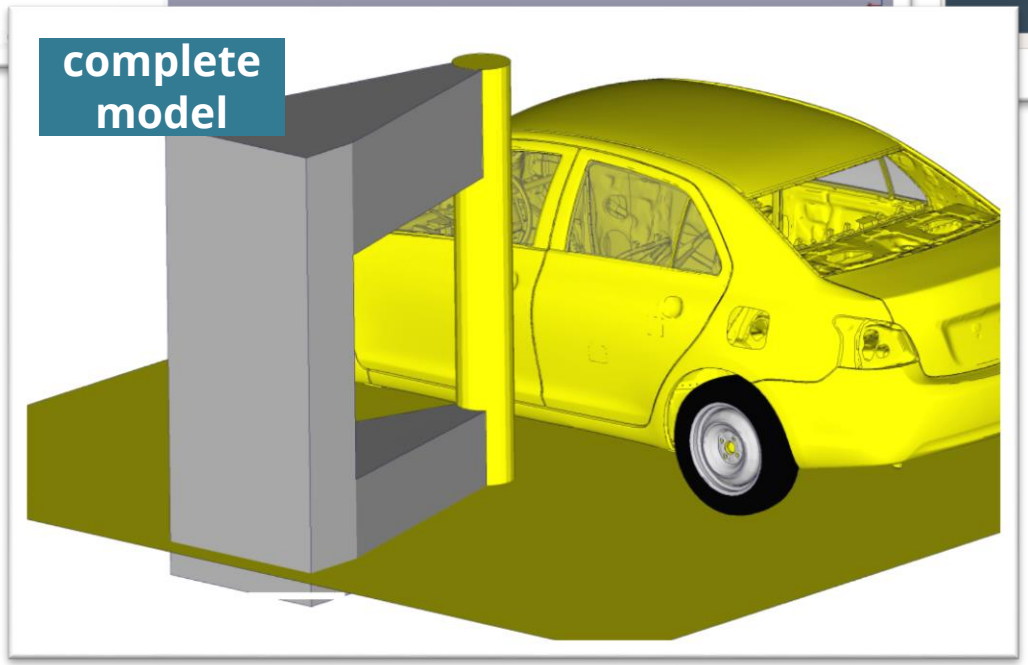
Outlook – *upcoming GUI for designers in CAx-Hub*



Outlook – *public DEMO setup using Freecad and ANSA*







- CAD model in Freecad
  (free and open-source CAD software)
- Mesh generated by ANSA from CAD data
- Shared Connection definitions
- FE model for different solvers and disciplines
  (including LS-DYNA for NVH and Crash)

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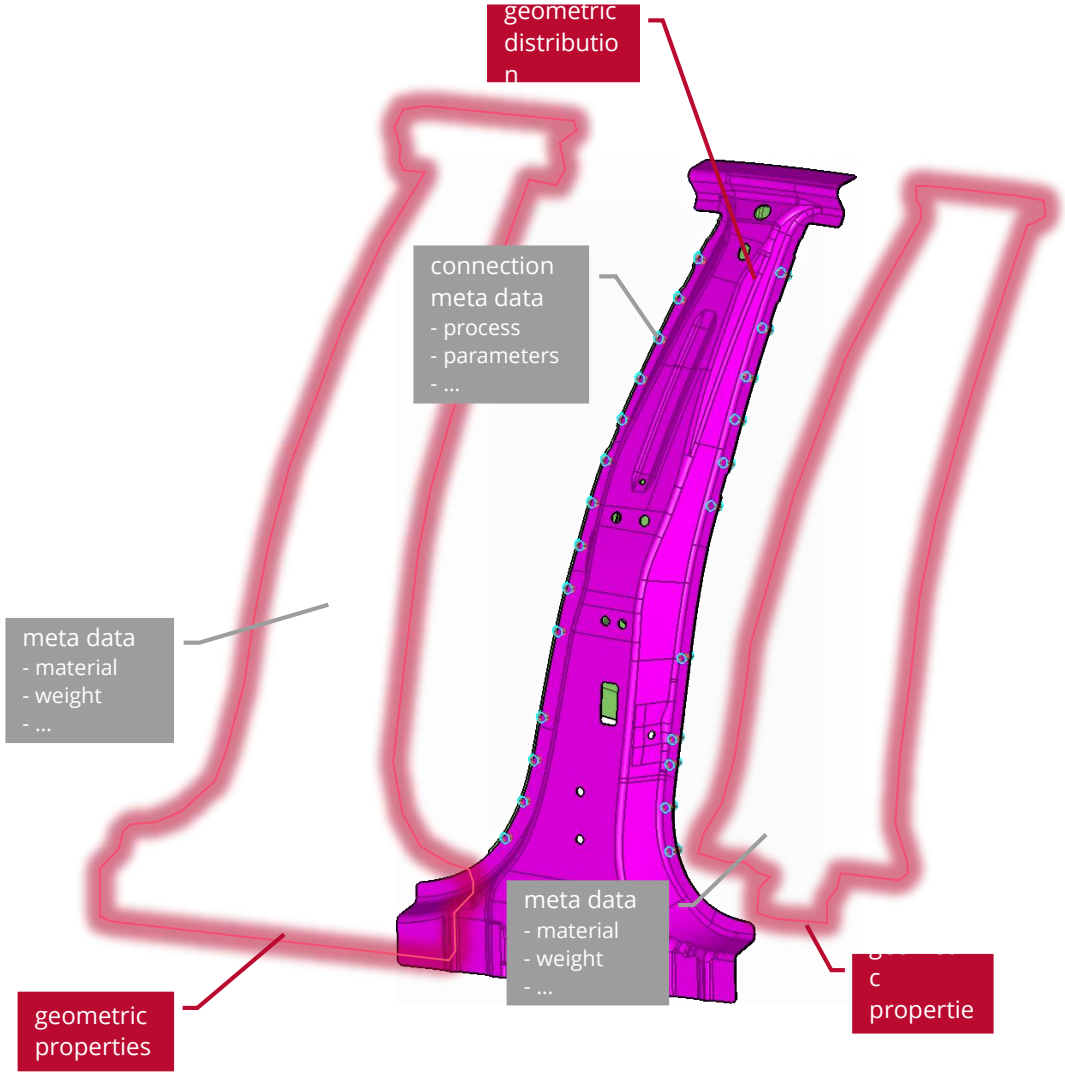
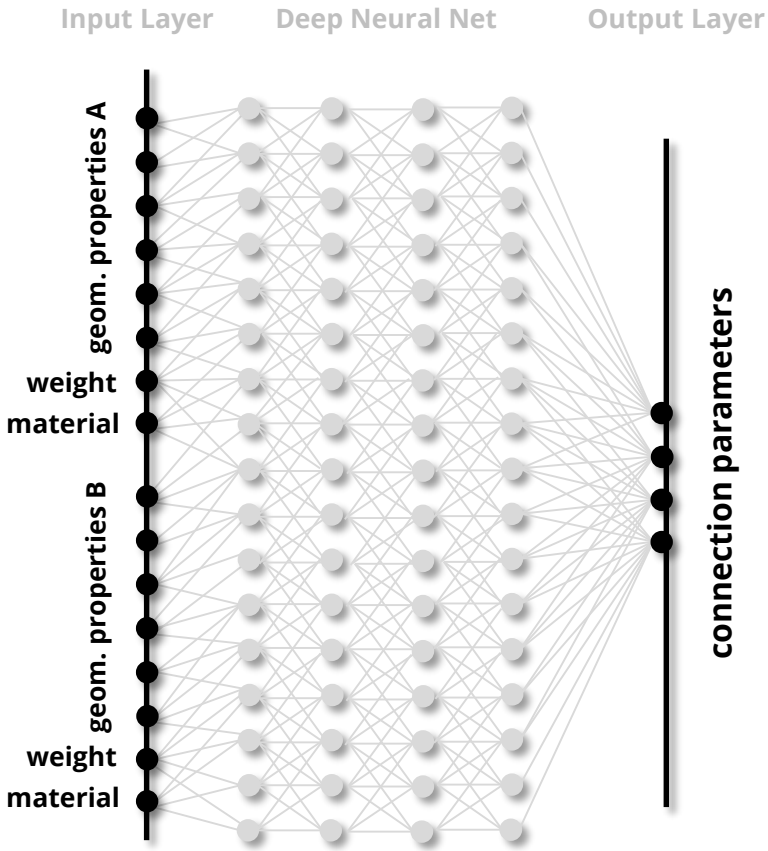
so long, and thanks for all the fish...

Outlook – *using AI to generate initial spot weld designs*





- Training data extracted from existing FEM data
- Estimation for initial spot weld layout with NeuralNet computed fast on local client

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