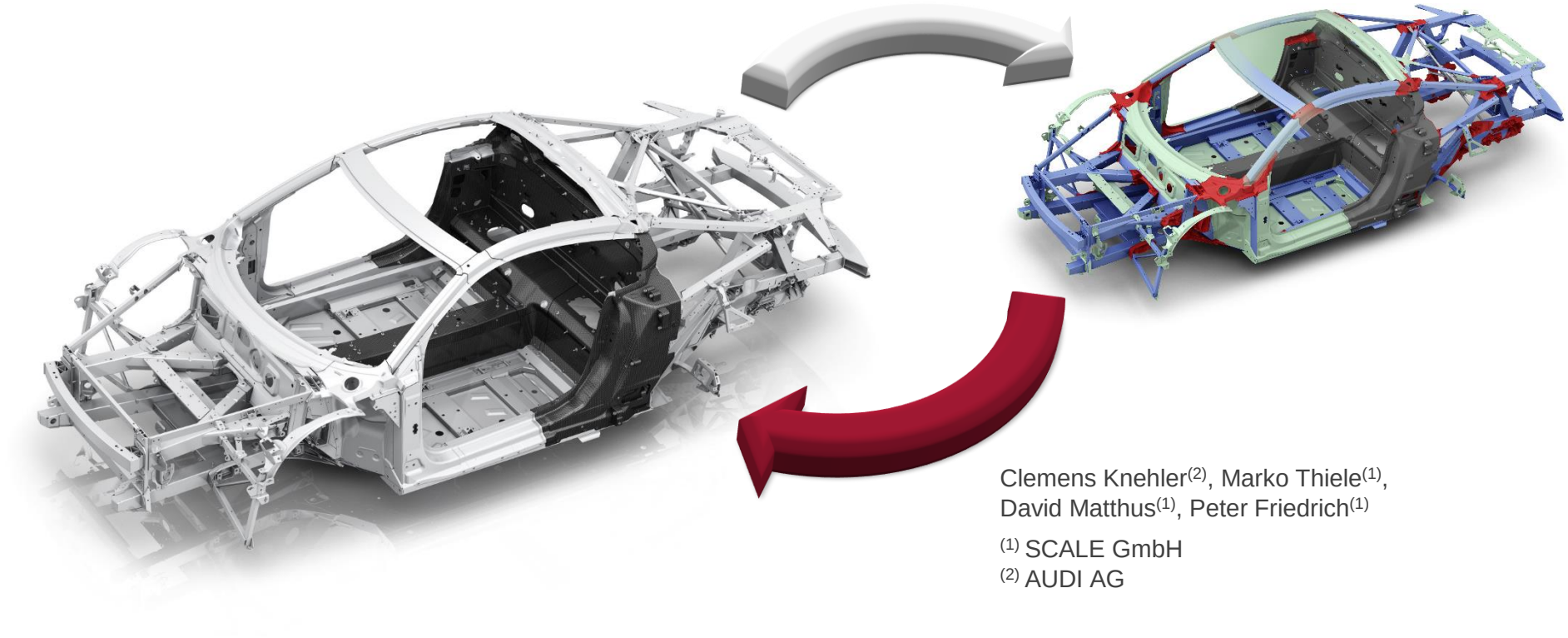
Prospects of integrating CAD and CAE in Simulation Data Management



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[1] SCALE GmbH
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Presented at the NAFEMS European Conference
Simulation Process and Data Management (SPDM)
28-29 November 2018, Munich, Germany

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

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* Disclaimer: This has not been deployed to a productive environment! The intend was to investigate workflows.

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Integrating CAD and CAE

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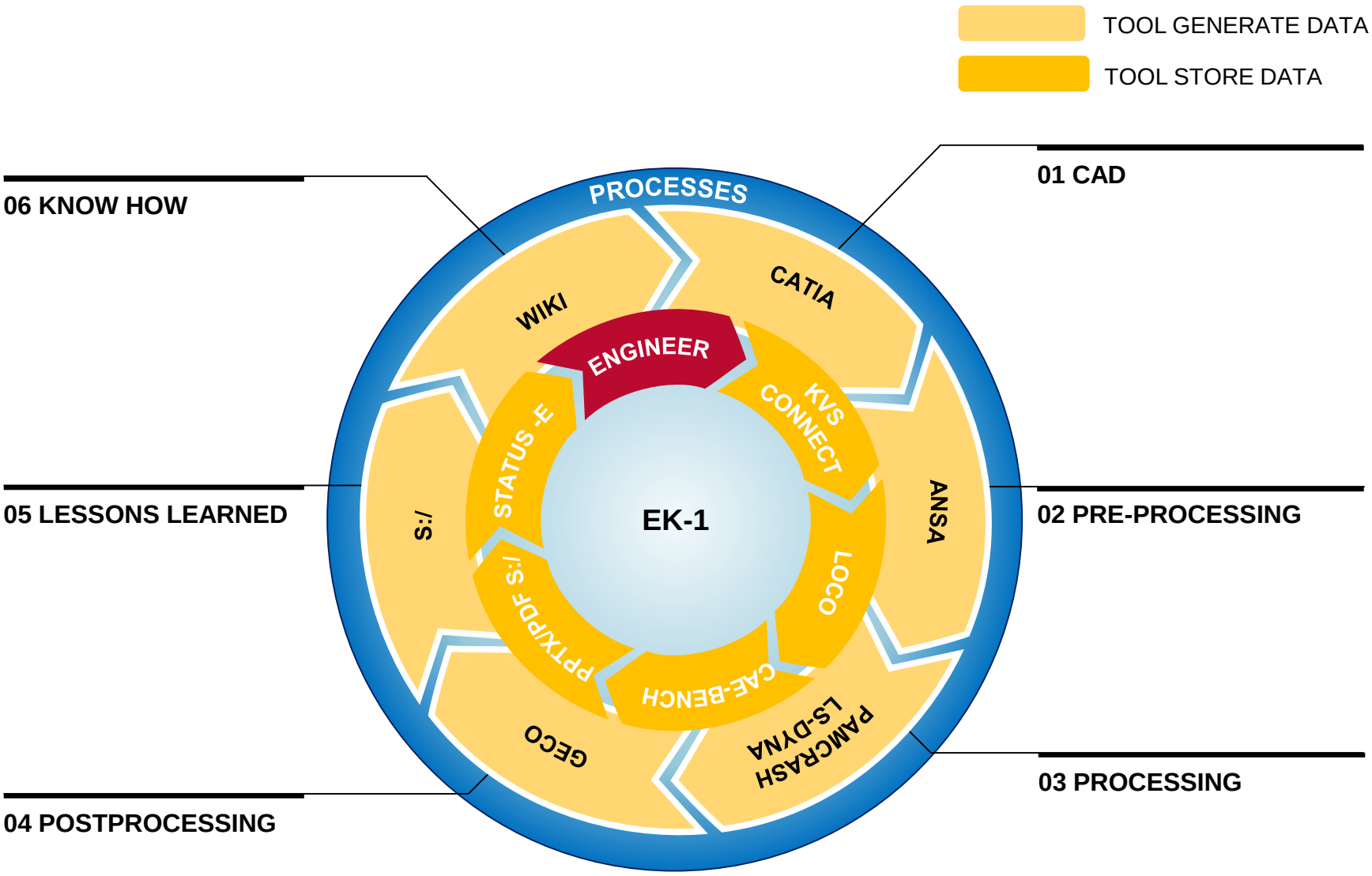
Integrating CAD and CAE - *motivation for Body18*



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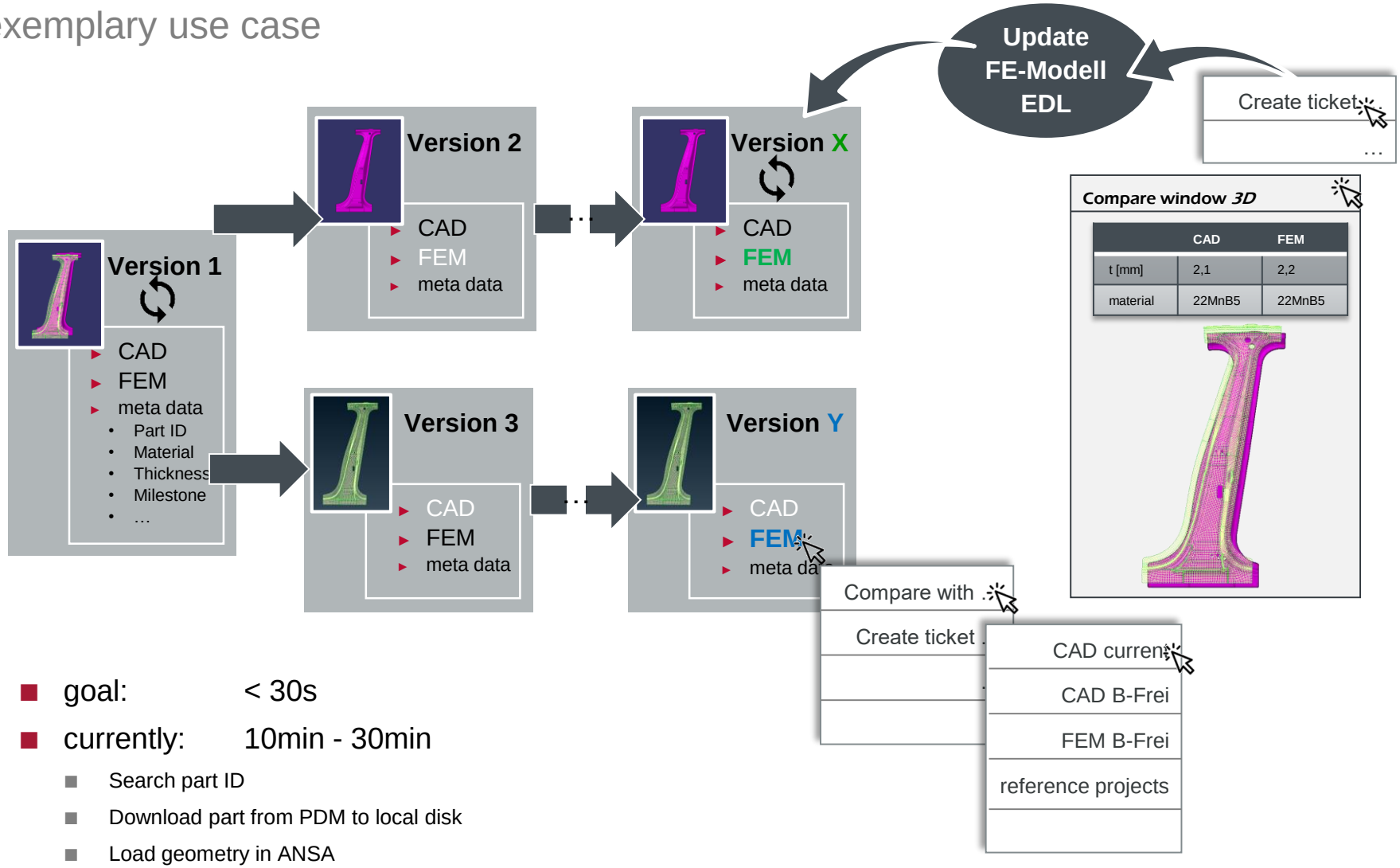
Integrating CAD and CAE - *motivation for Body18*

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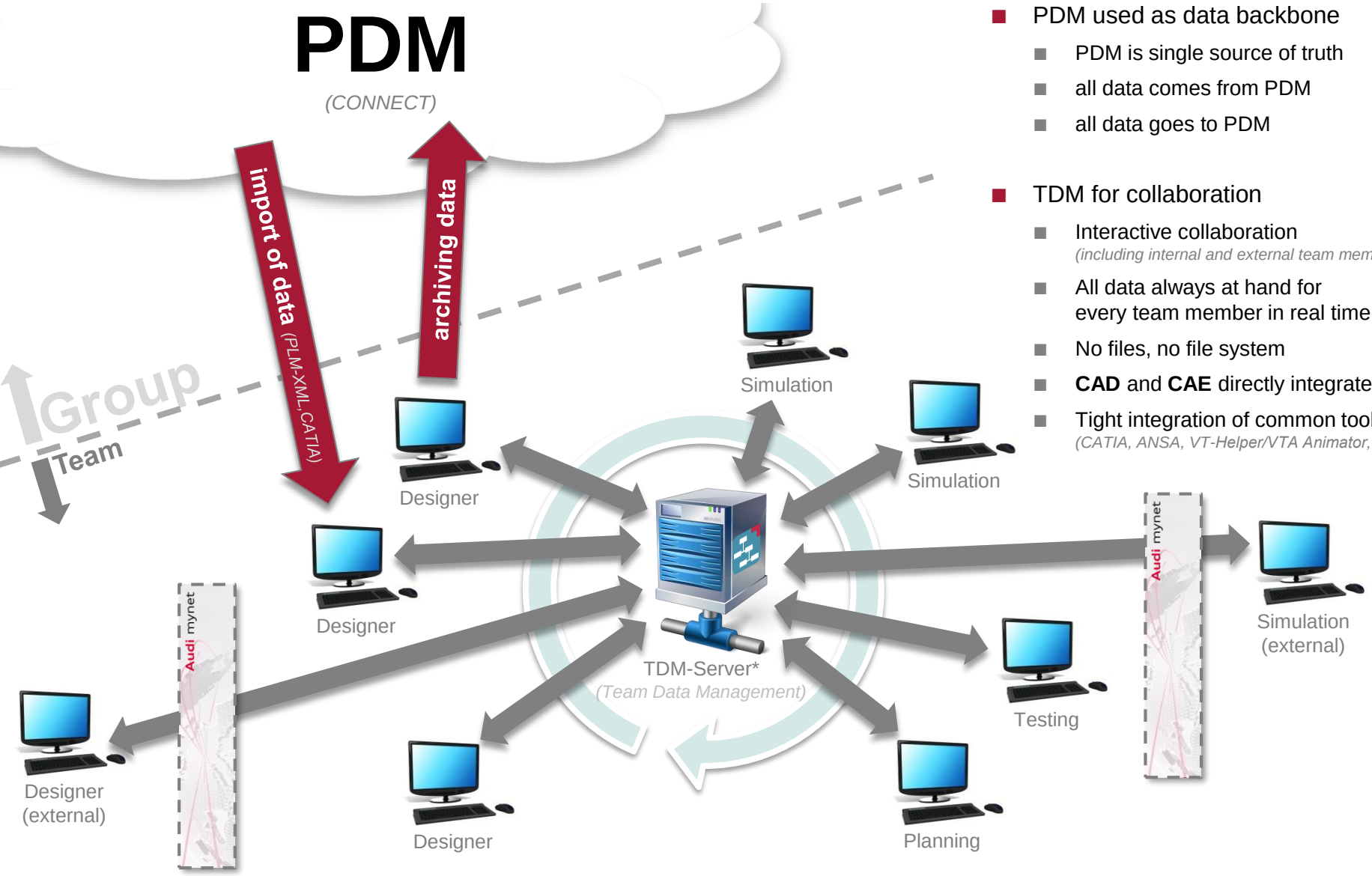
Body18 “Proof of Concept” at AUDI - *setup*



- PDM used as data backbone
  - PDM is single source of truth
  - all data comes from PDM
  - all data goes 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 development instance of the LoCo-Server installation

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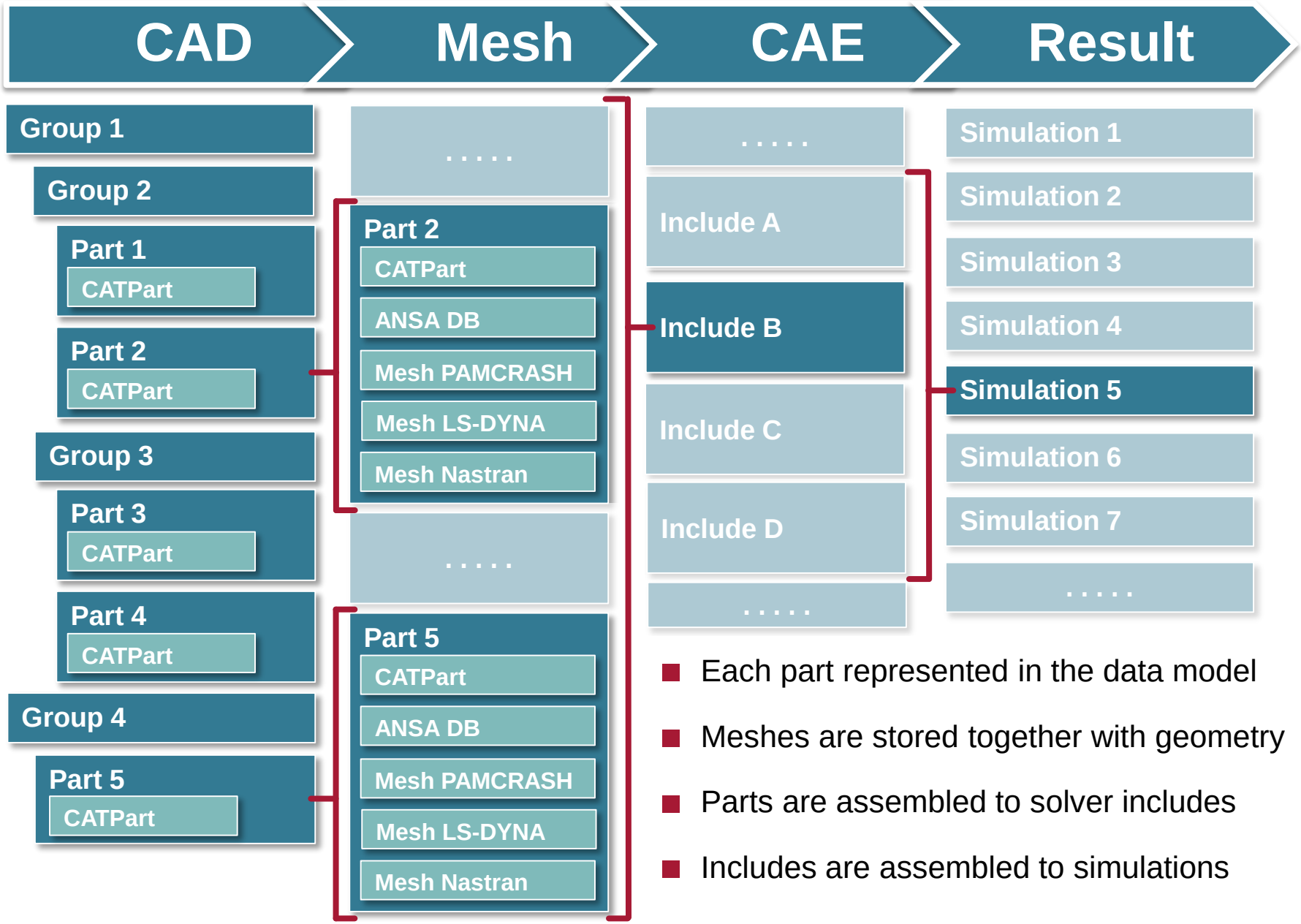
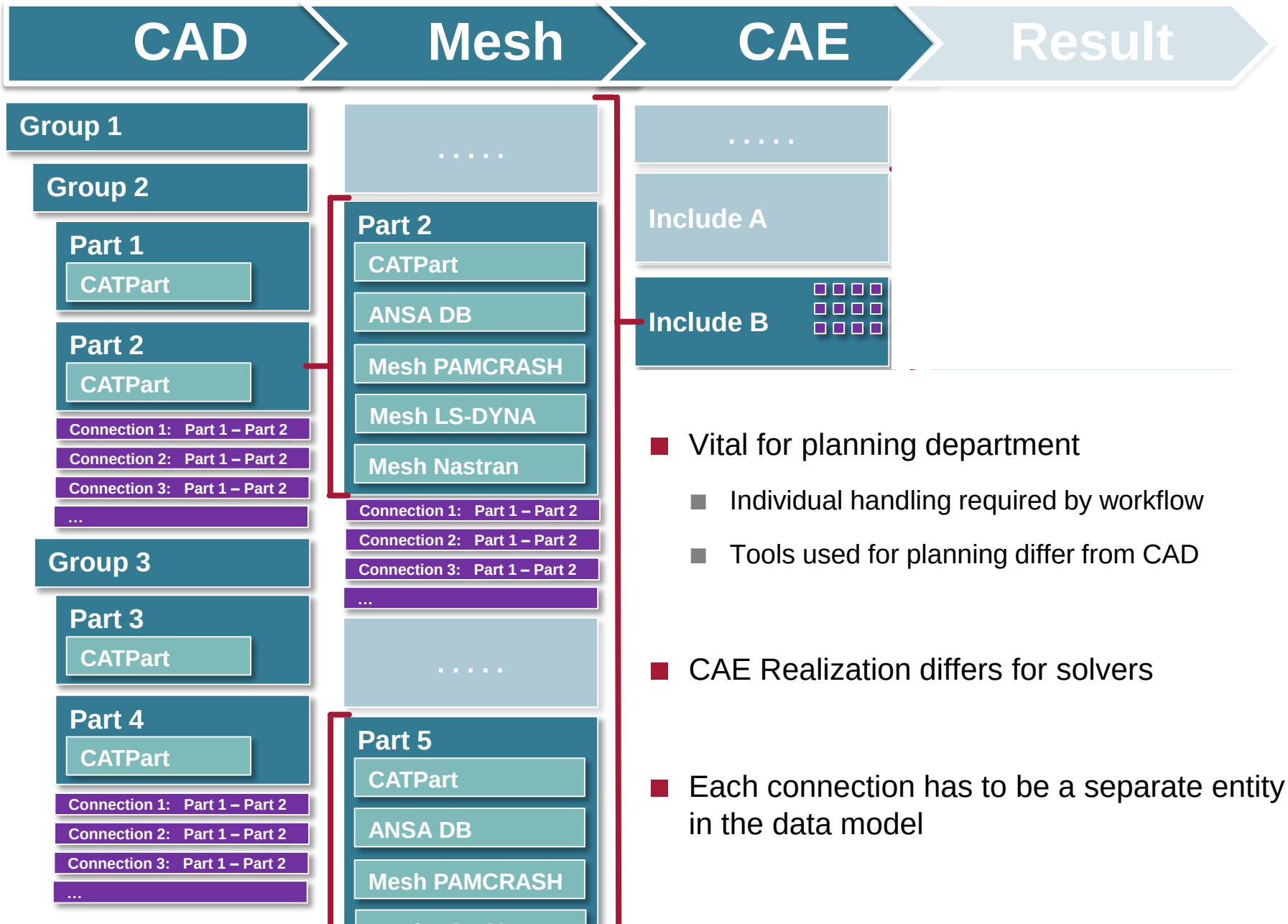
Proposed Approach - *data model*



- 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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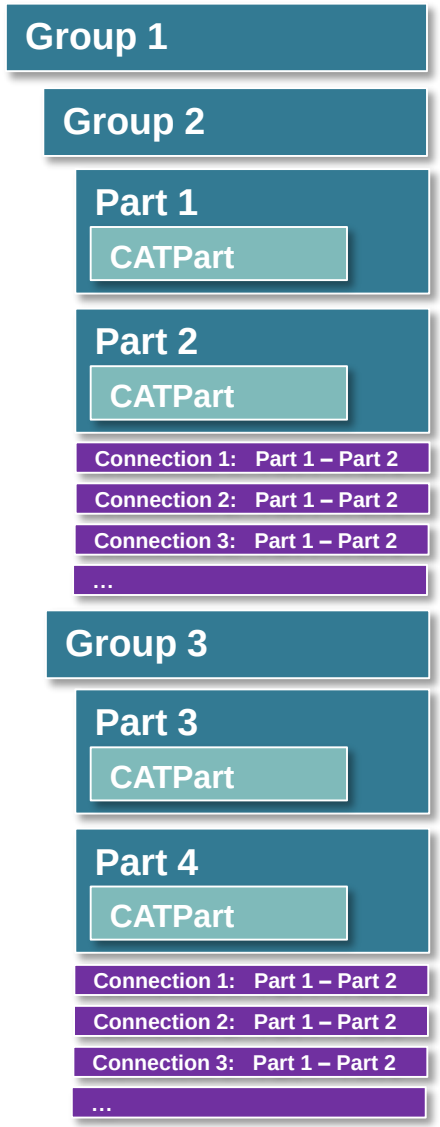
Implementation - *CATIA*

CAD Mesh CAE Result



Callenges

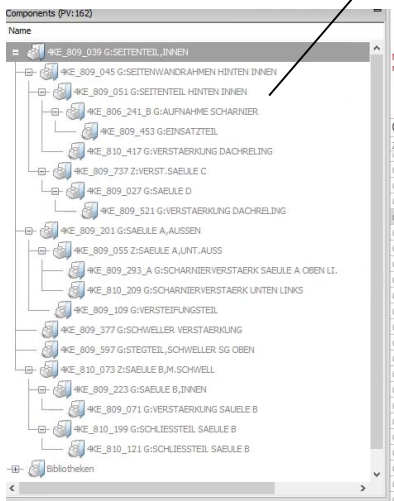
- Simultaneous editing in CATIA by multiple team members
- Handling of connections and metadata directly in TDM
- Changes made in TDM have to be reflected in CATIA and vice versa
- Fast loading into CATIA
- ….

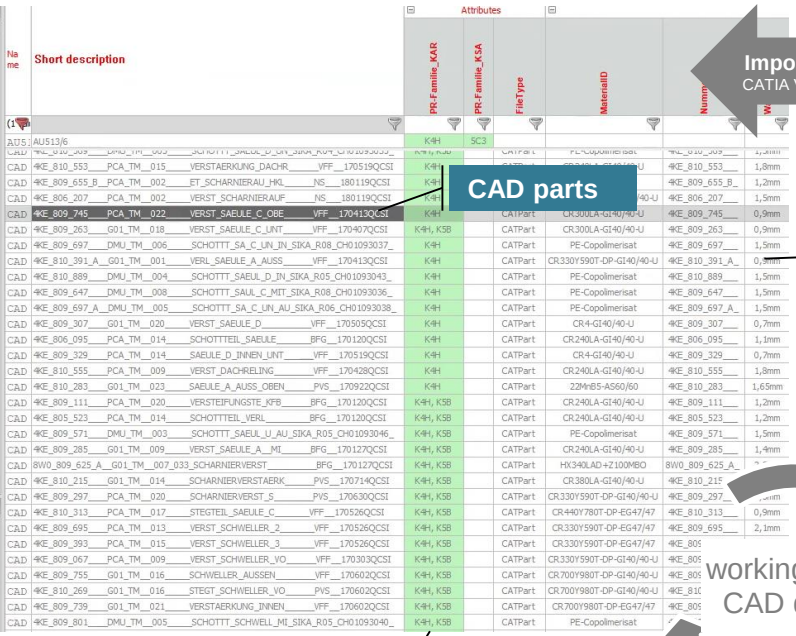
Implementation - *CATIA*

CAD | Mesh | CAE | Result

product structure from CATIA

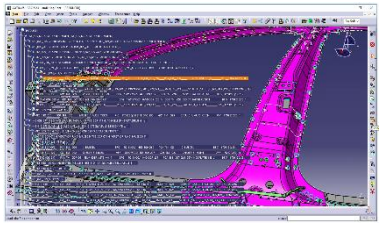
Body18





Import CATIA V5

CATIA V5

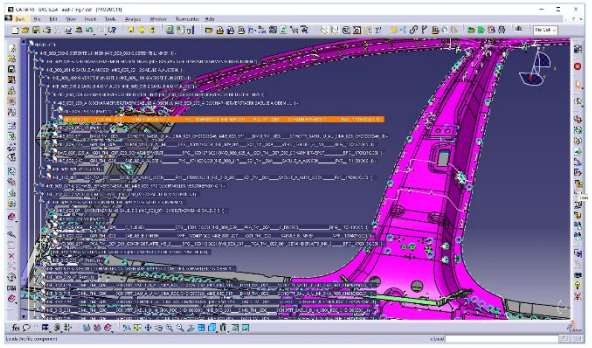


PDM System (CONNECT)

CAD meta data

working with CAD data

CATIA V5

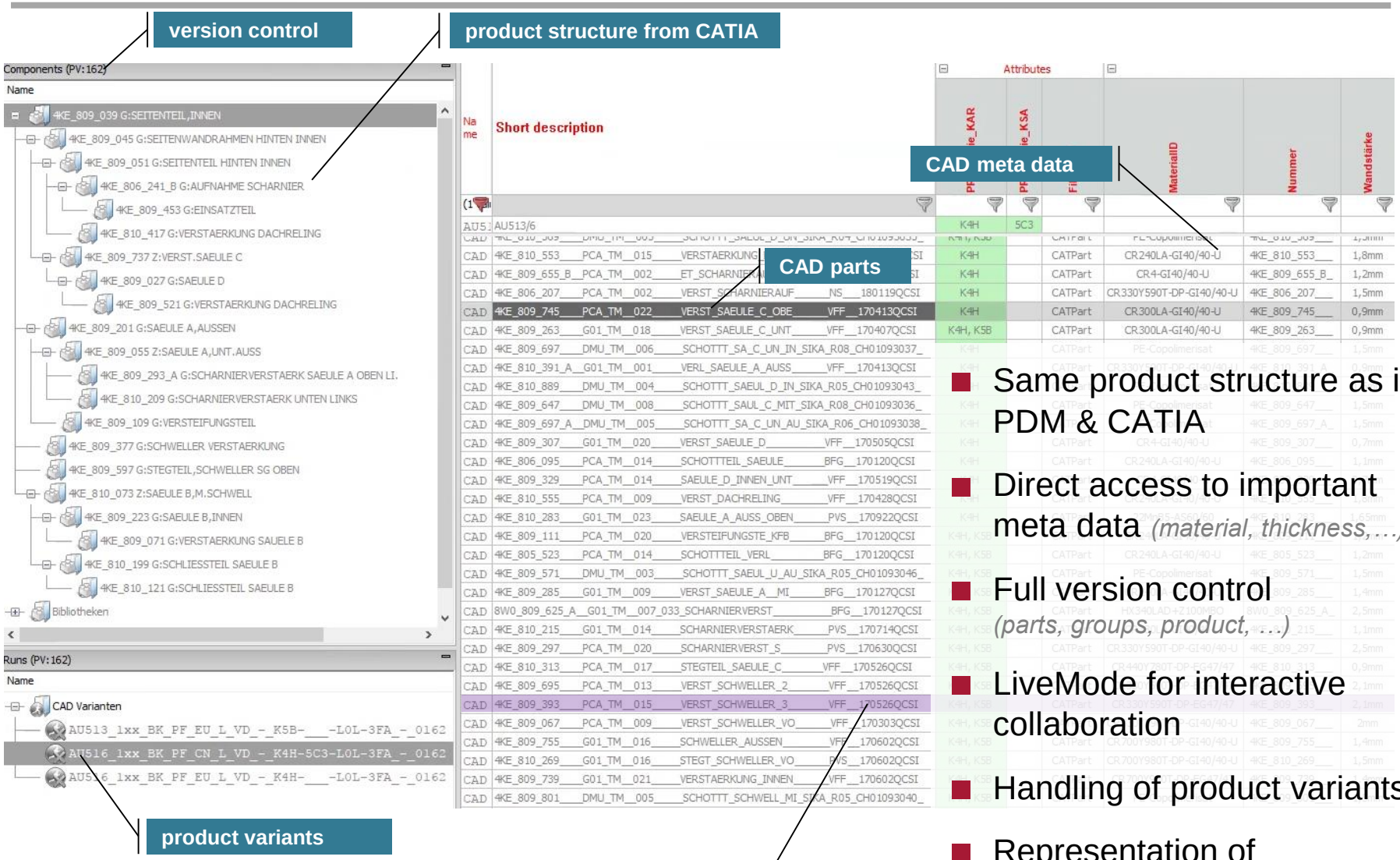


product variants

control of variants

Audi

Implementation - *handling CAD data*



- 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

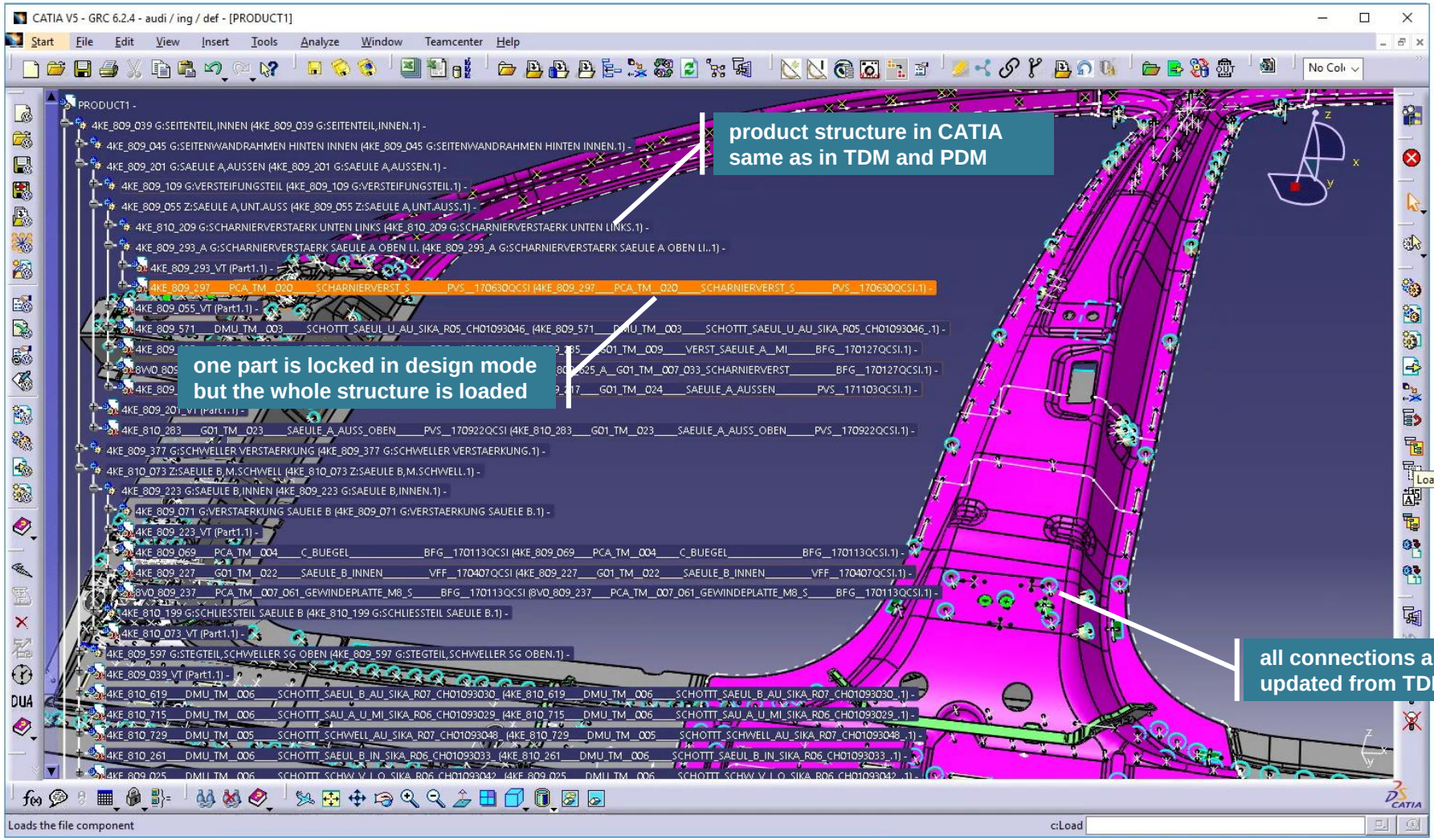
Audi

Implementation - *CATIA*

CAD | Mesh | CAE | Result

CATIA V5*

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



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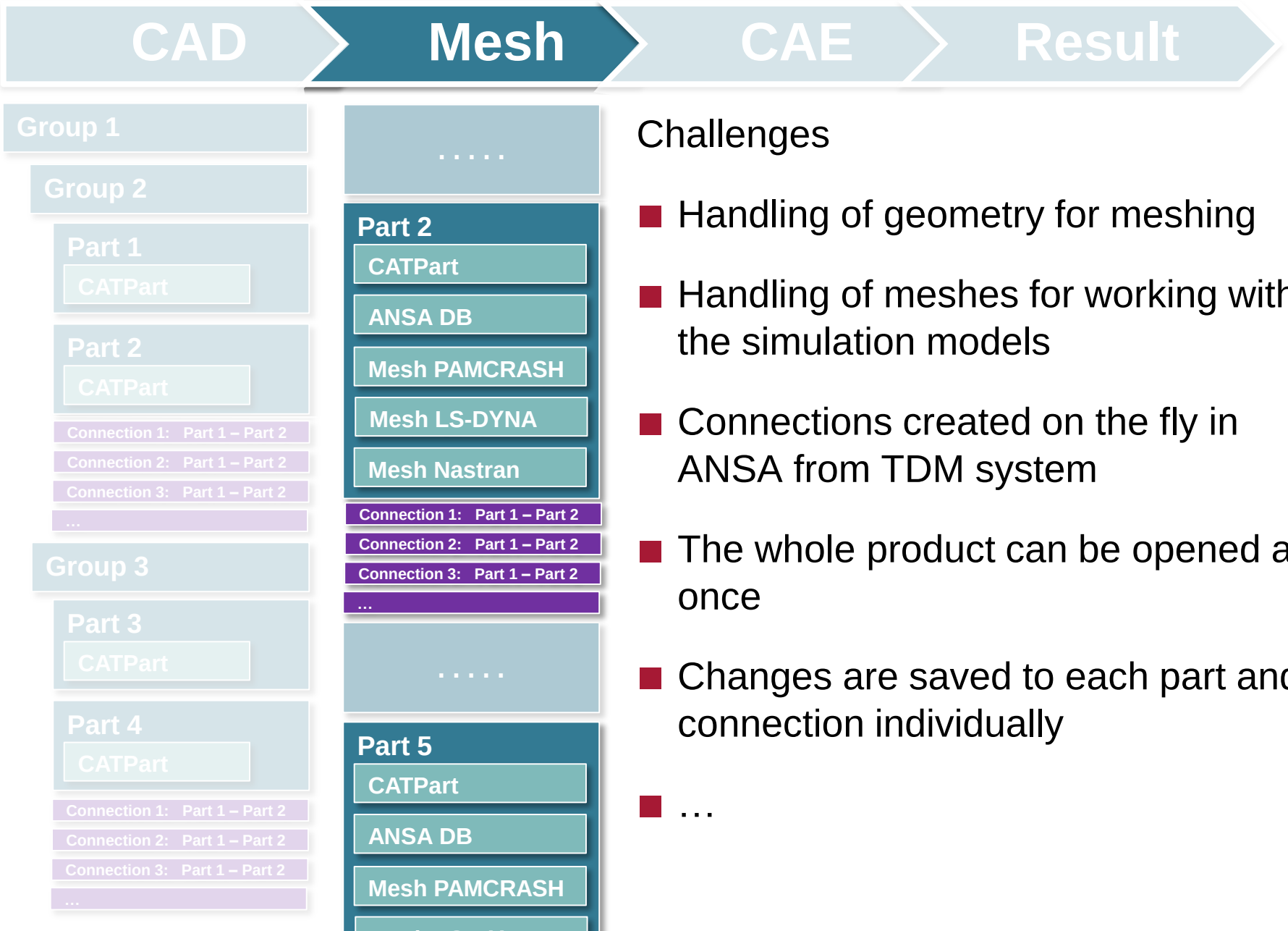
Implementation - *ANSA*



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*

Body18

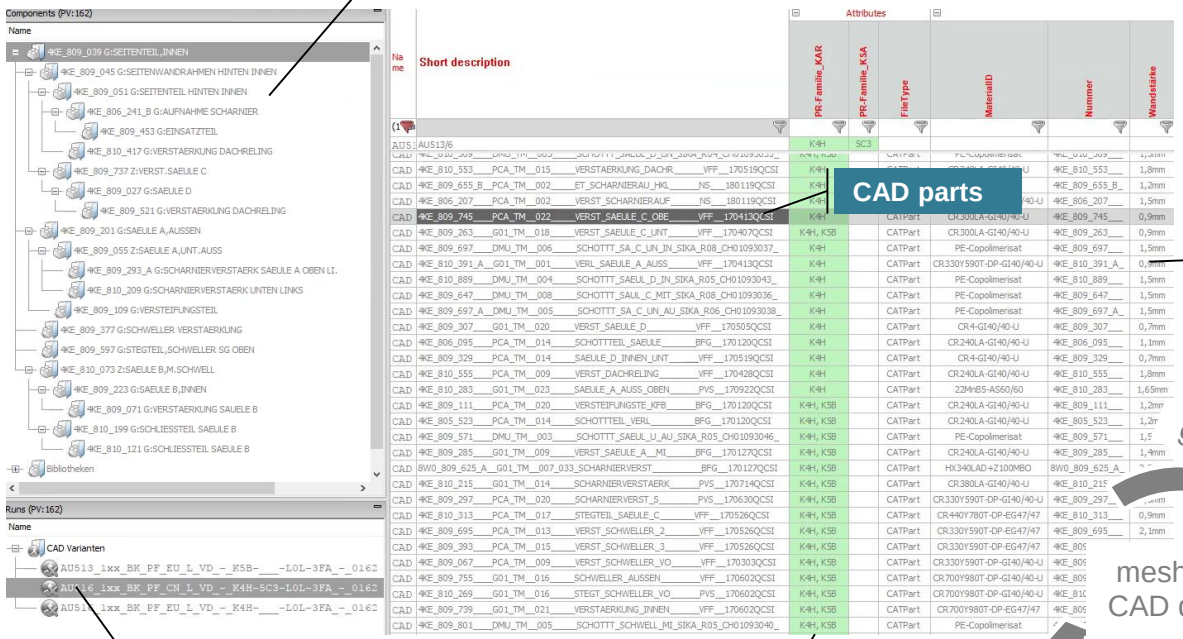
product structure from CATIA

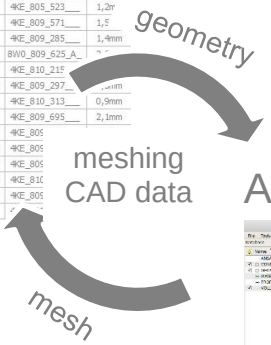
CAD parts

CAD meta data

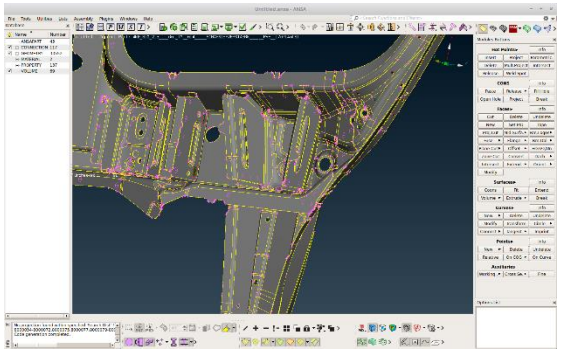
product variants

control of variants





ANSA



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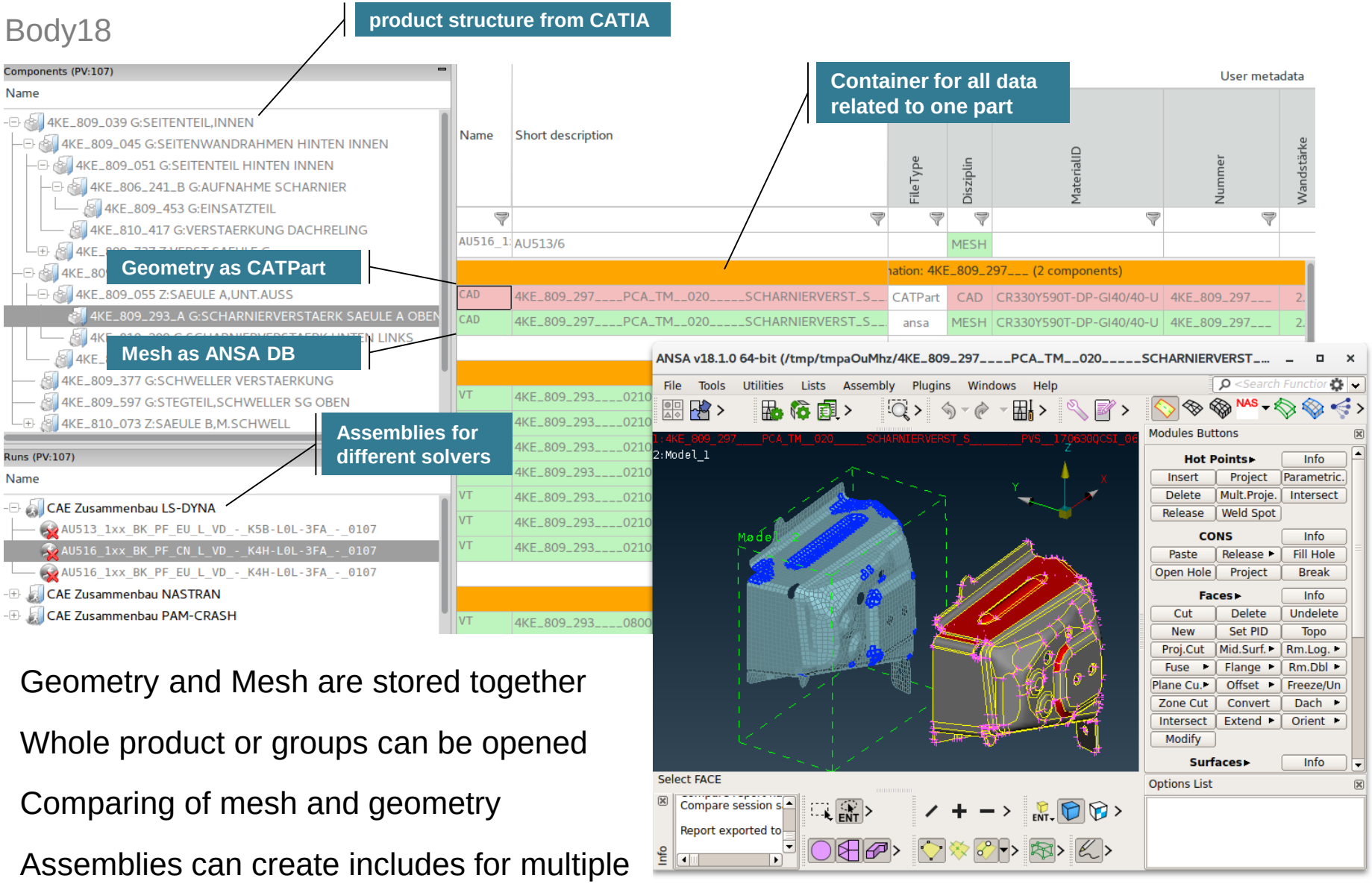
Implementation - *ANSA*

Body18

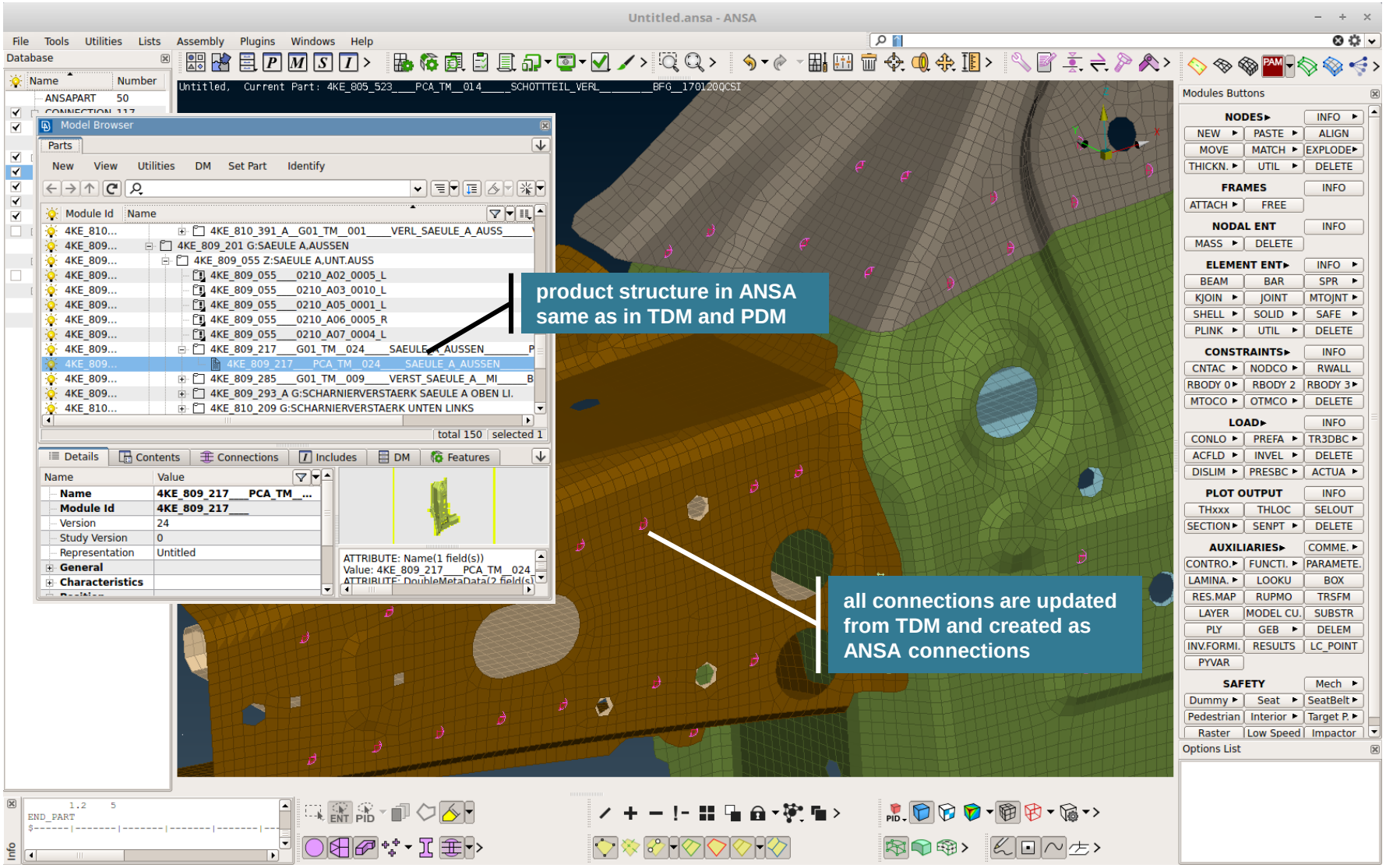


- Geometry and Mesh are stored together
- Whole product or groups can be opened
- Comparing of mesh and geometry
- Assemblies can create includes for multiple solvers

Implementation - *ANSA*

CAD | Mesh | CAE | Result

ANSA



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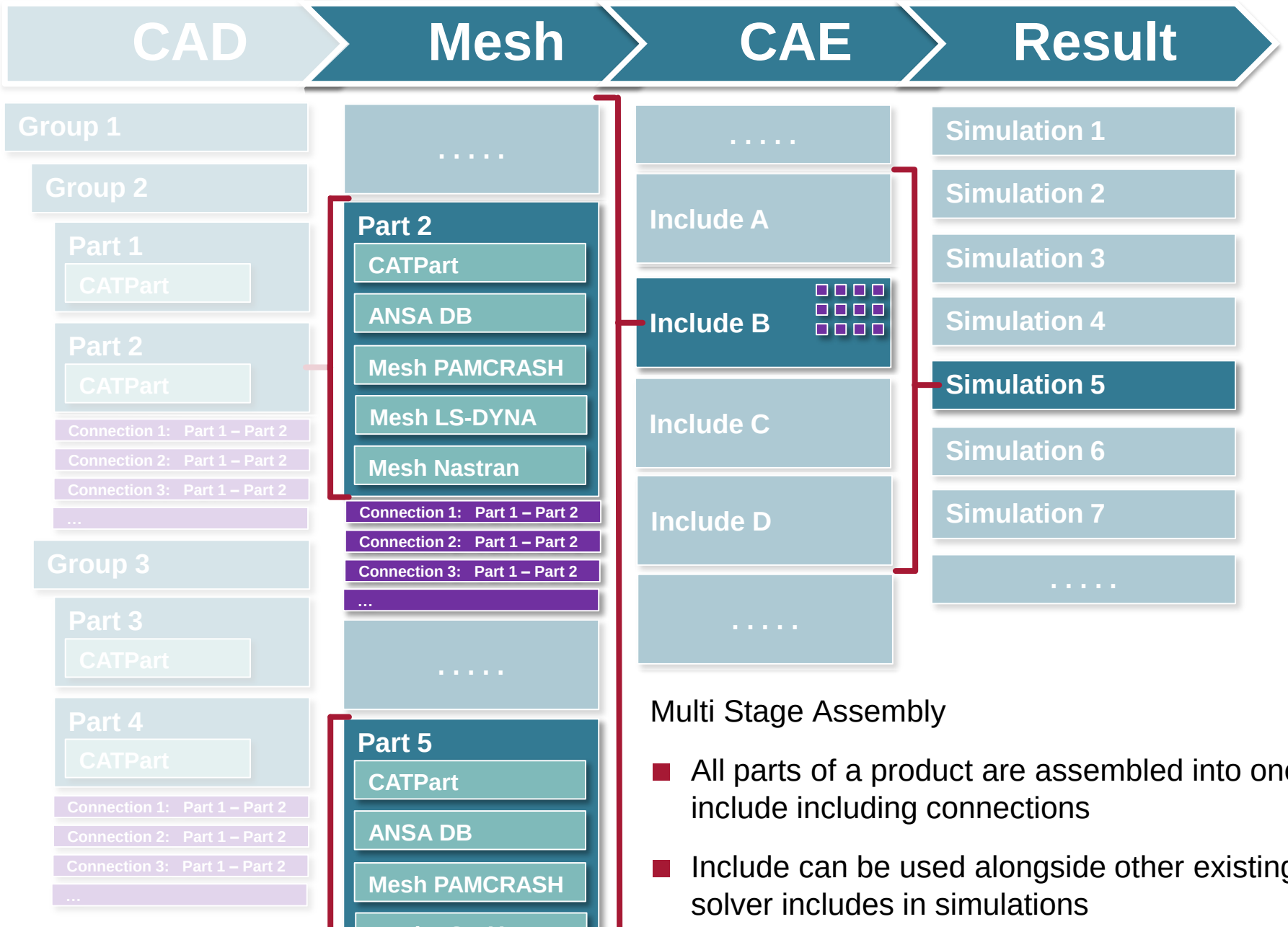
Implementation - *closing the gap to CAE*



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

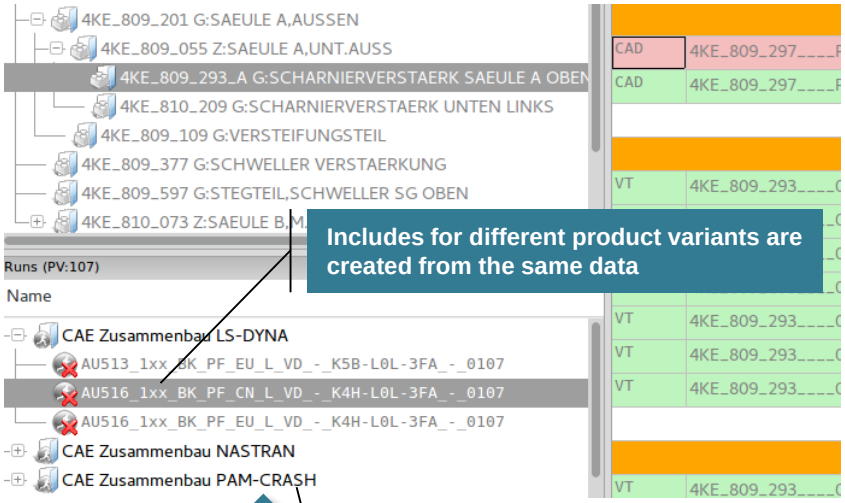
Implementation - *closing the gap to CAE*

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.

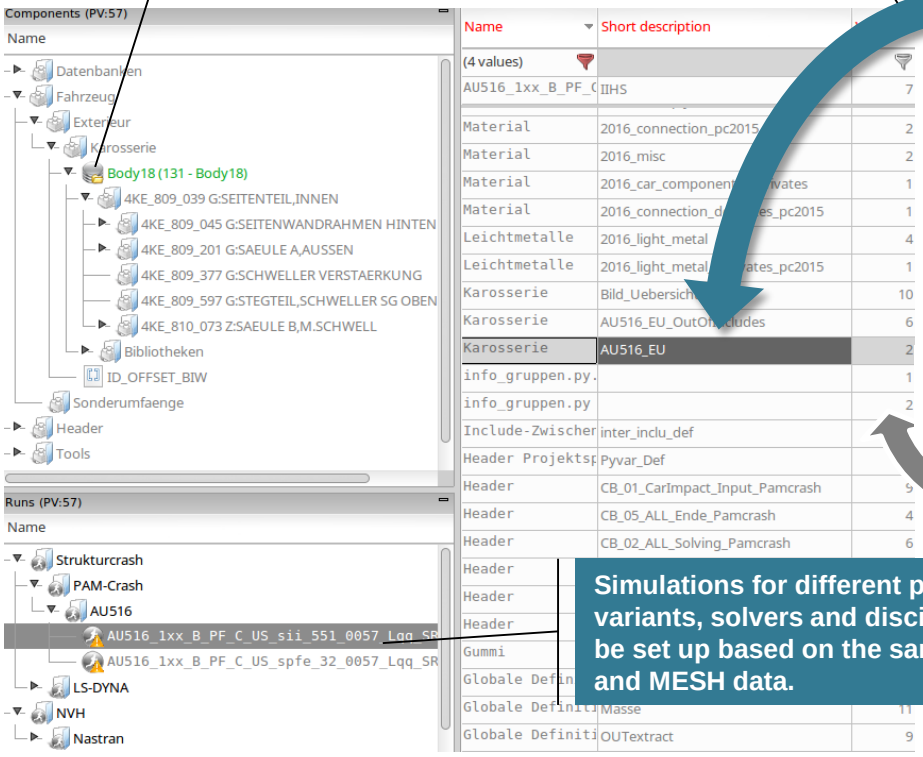
CAD



Includes for different product variants are created from the same data

CAE

CAD body in white pool mounted in simulation pool

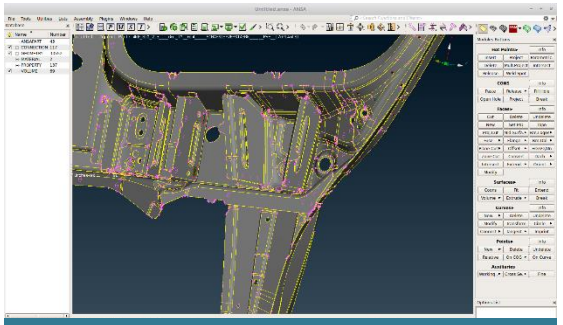


working on the simulation model

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

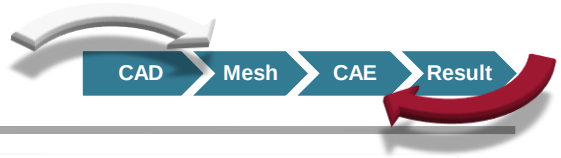
ANSA

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

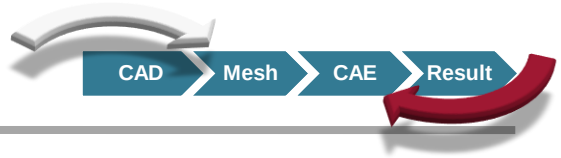
Implementation - *project management*



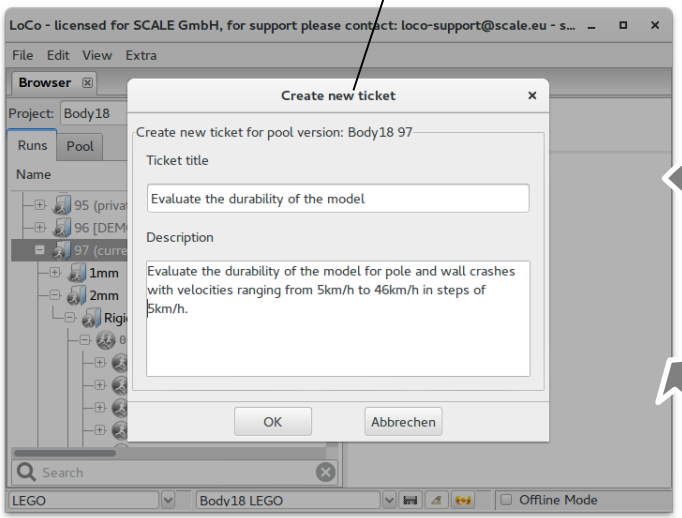
CAD **Mesh** **CAE** **Result**

- Notifications
- Requests
- Tasks

Implementation - *project management*

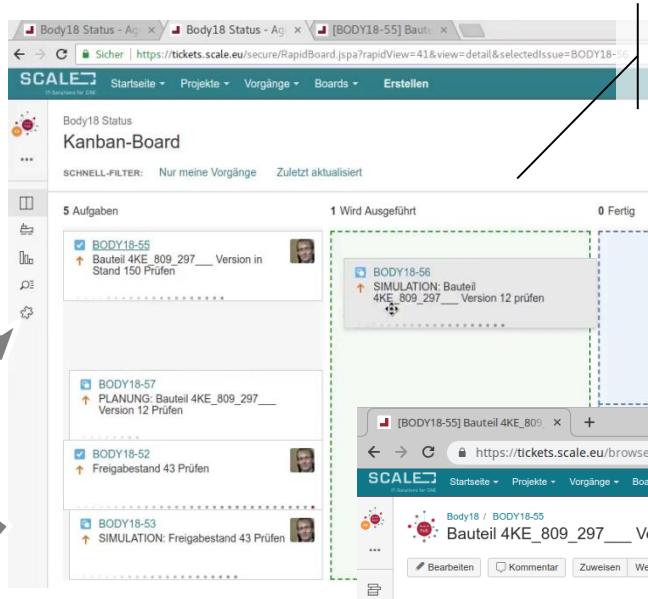


Tasks are created directly with the desktop clients

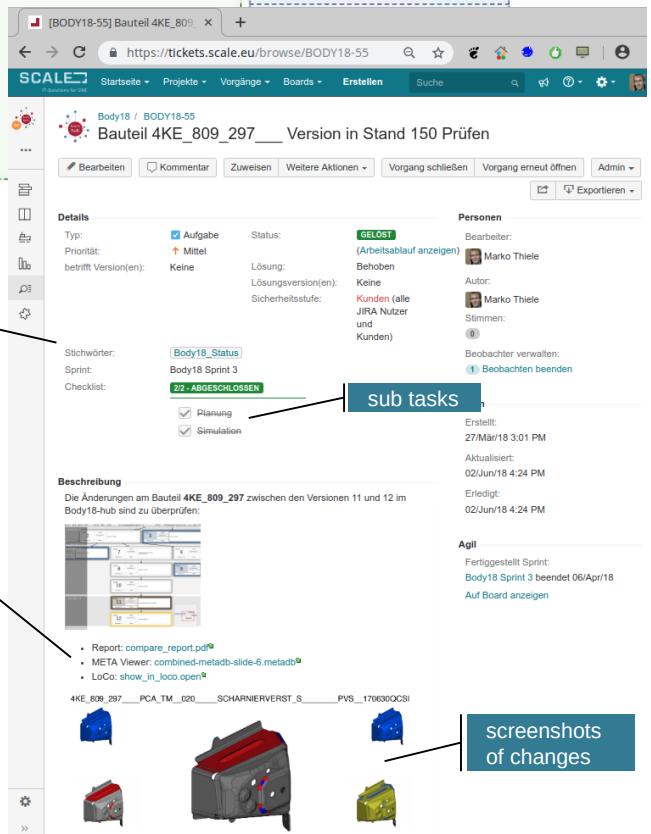


Integration with project management system

Kanban-Board for easy task management



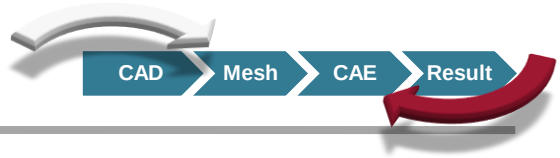
detailed task description with automatically created contend



- 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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so long, and thanks for all the fish…