Collaborating with CAE-processes and -data across several brands of the VW-group

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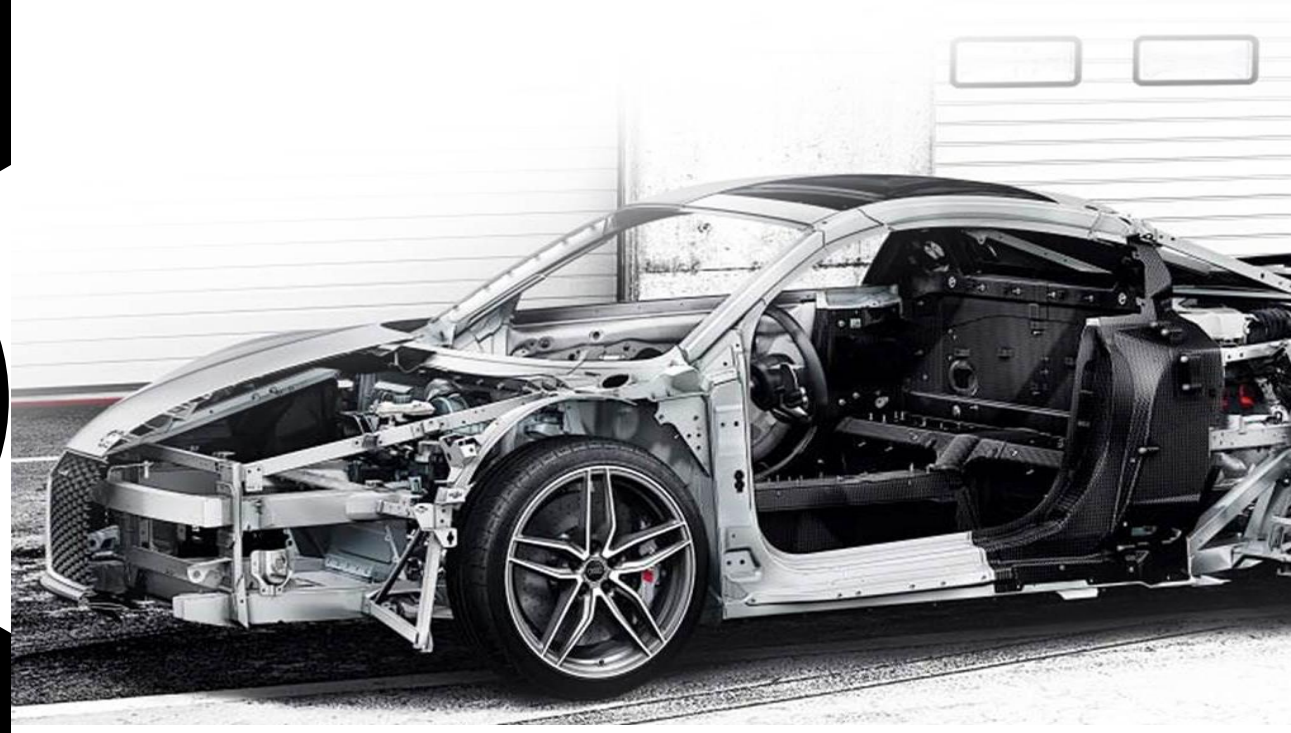


Agenda

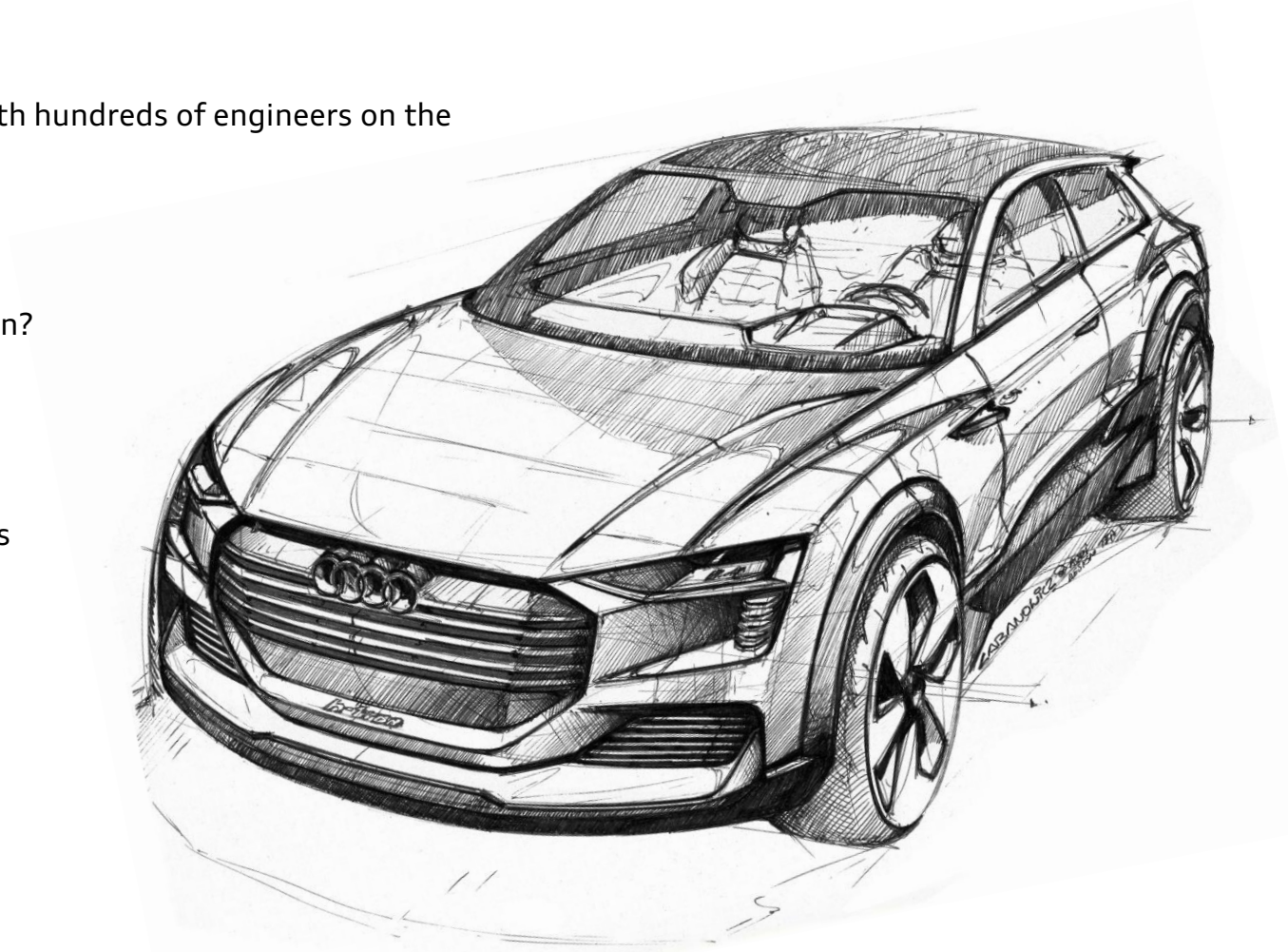
01 **Motivation**
Where do we come from? & Why using data management for crash simulation?

02 **Collaboration**
Teamwork in a heterogeneous environment with hundreds of engineers on the same projects.

03 **Data structures**
How to organize data for effective collaboration?

04 **System integration**
CAE-Tools, HPC, Archiving of simulation results

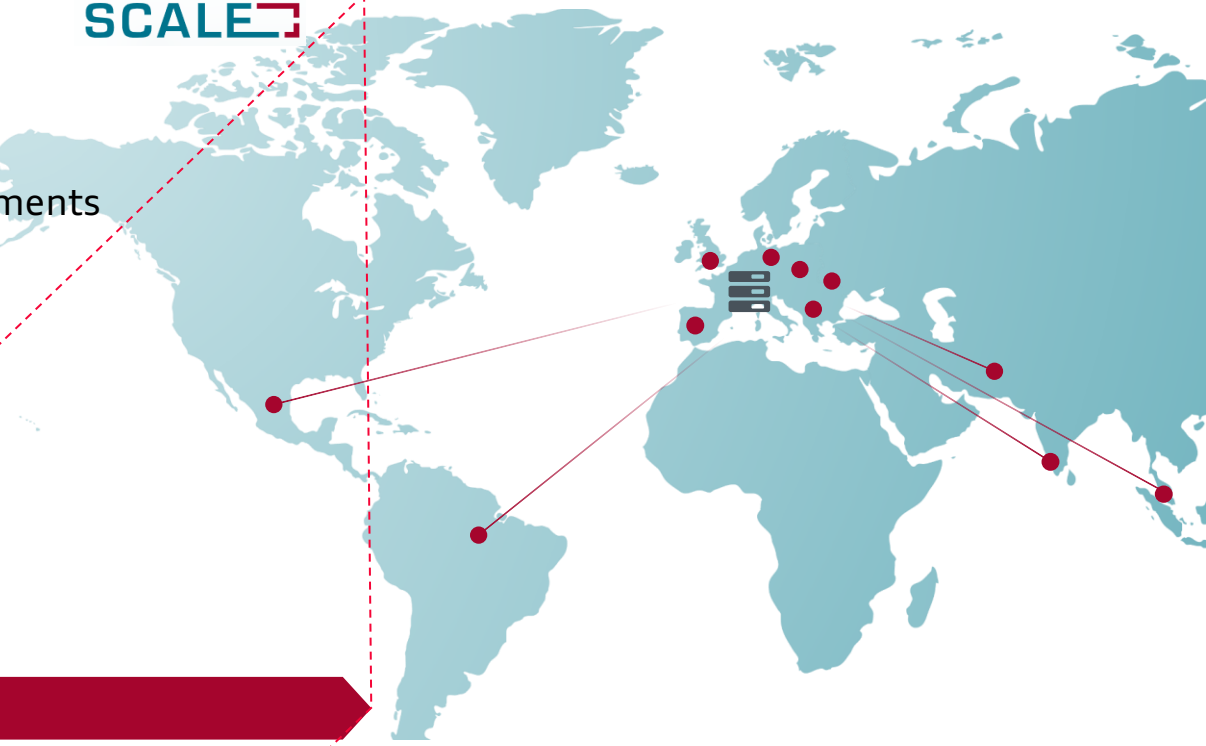
05 **Summary & outlook**
CAViT (SCALE.result), ...



Motivation

rising dimensions of complexity

LoCo SCALE



- Requirements
  - Legislation
  - Consumer tests
  - Customer requirements *(convenience)*
  - Sustainability
  - …

Requirements

Interaction

Product

Organisation

- Collaboration
  - Project lead engineers
  - Methodology responsibles
  - External engineers
  - Simulation disciplines
  - Tier one suppliers
  - Joint ventures
  - …

- Projects and derivates
  - Body variants
  - Types of vehicles *(BEV, HEV, PHEV, ICE, …)*
  - Interieur configurations
  - Different markets
  - …

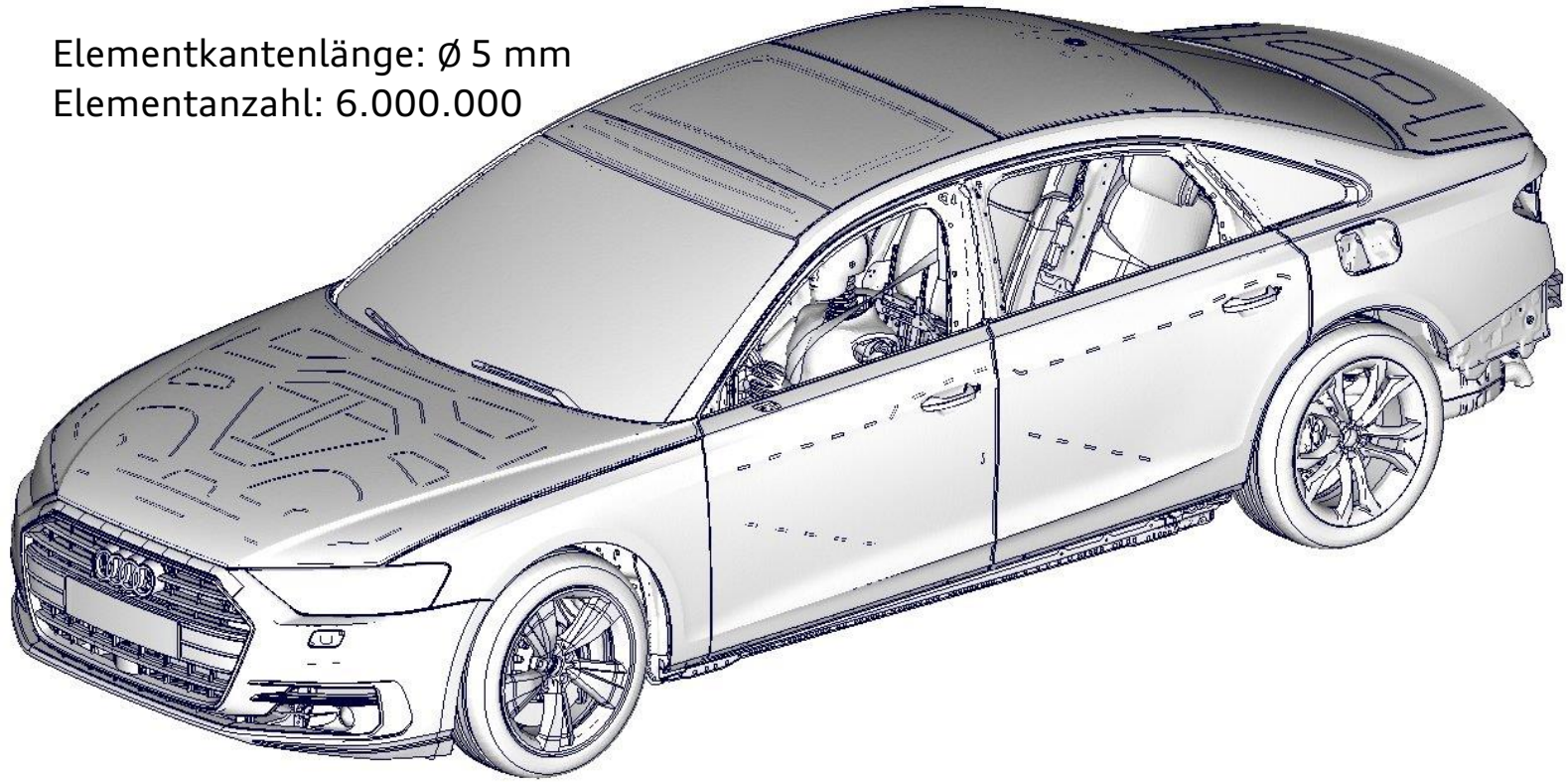
Motivation

increasing complexity of simulation models

- Increasing level of detail for models
  - More elements
  - More components
    (sub models)
  - More details
  - Interdisciplinary content

2017 Audi D5

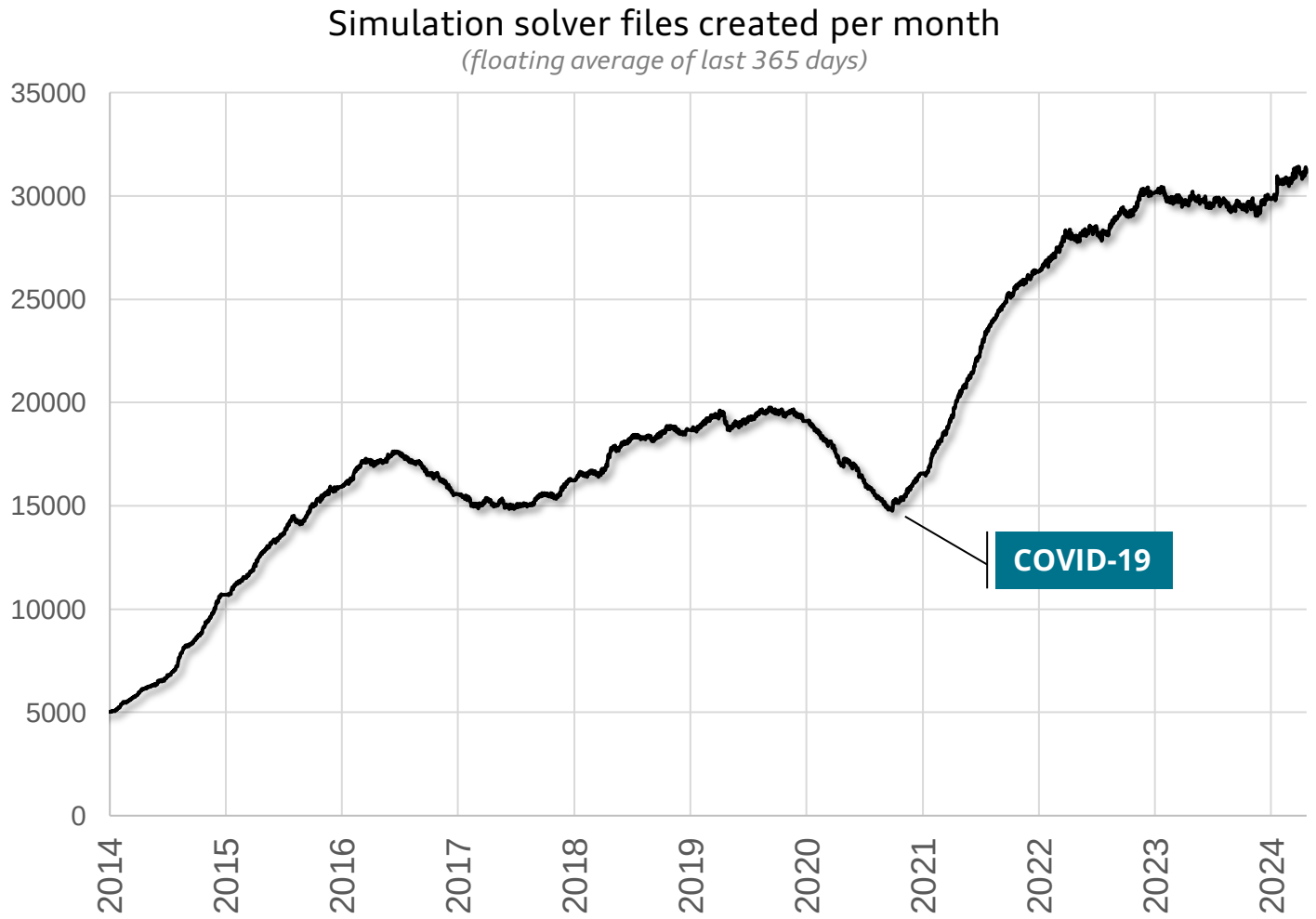
Elementkantenlänge: Ø 5 mm
Elementanzahl: 6.000.000



Motivation

usage of LoCo within VW-Group

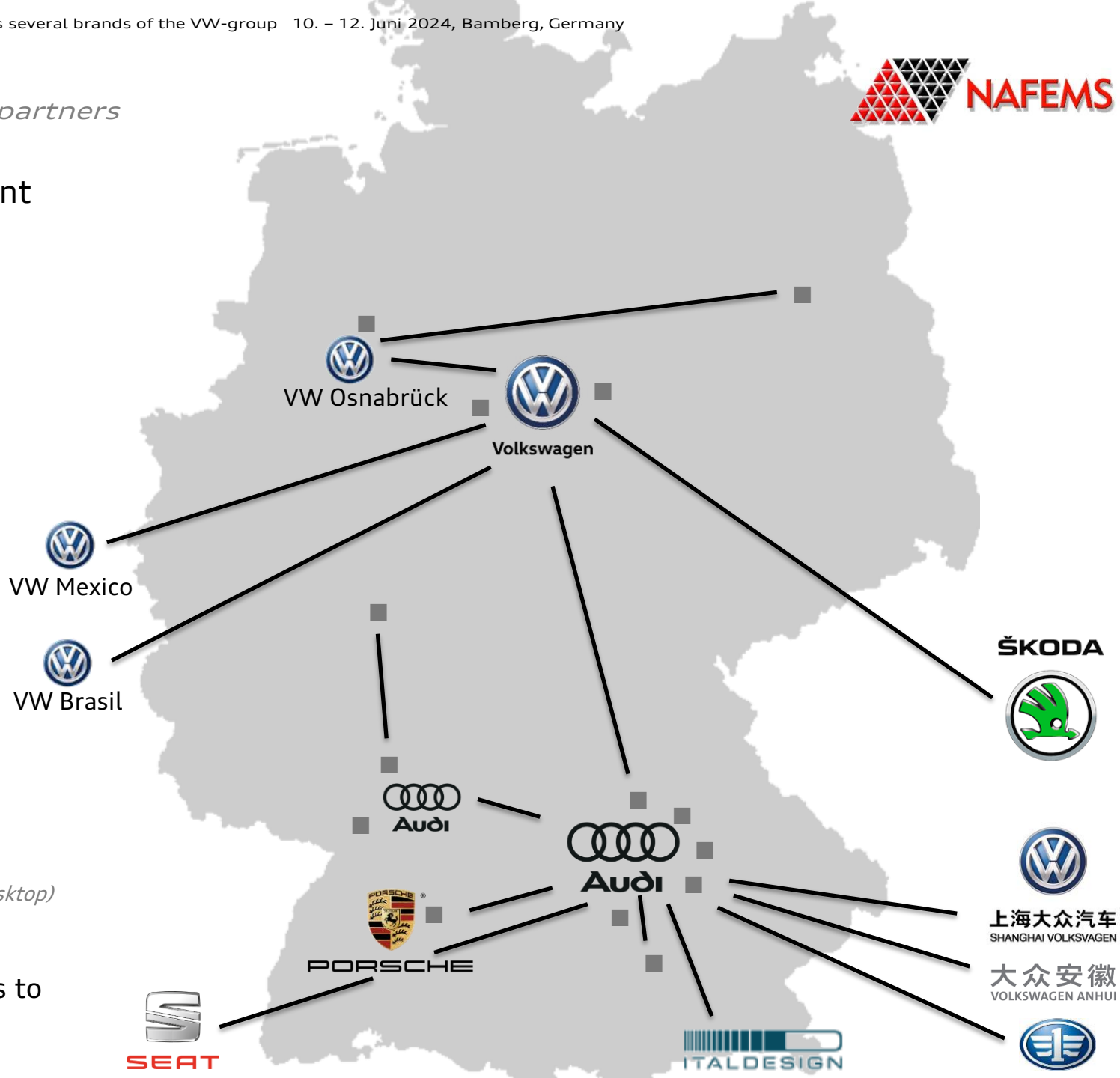
- ~1100 users during last 365 days
- Data since 02-2011
  - ~7.8 million assembled simulations
  - ~2.8 million component versions
  - ~800 thousand pool versions
  - ~60TB of simulation input data
- Simulation Disciplines *(~23 different disciplines)*
  - Structural crash *(PAMCRASH, LS-DYNA)*
  - Occupant safety *(PAMCRASH, LS-DYNA)*
  - Interieur head impact *(PAMCRASH)*
  - Pedestrian safety *(PAMCRASH)*
  - Seat systems *(PAMCRASH)*
  - NVH *(PAMCRASH Implicit, NASTRAN, Abaqus)*
  - Multi Body Dynamics *(ADAMS)*
  - ...



Motivation

collaboration with other brands and external partners

- CAE is indispensable in vehicle development
- Engineers need to collaborate across many sites
- Several brands throughout the VW Group sharing CAE models and methods
  - Material libraries
  - Barriers, impactors, dummy models
  - Standardized solver control cards
  - Scripts, tools and process chains
- Engineering service suppliers and partners are integrated
  - Some partners work with VDI clients *(remote desktop)*
  - Some partners synchronize the CAE data
  - Some strategic partners use their own servers to synchronize data for larger teams



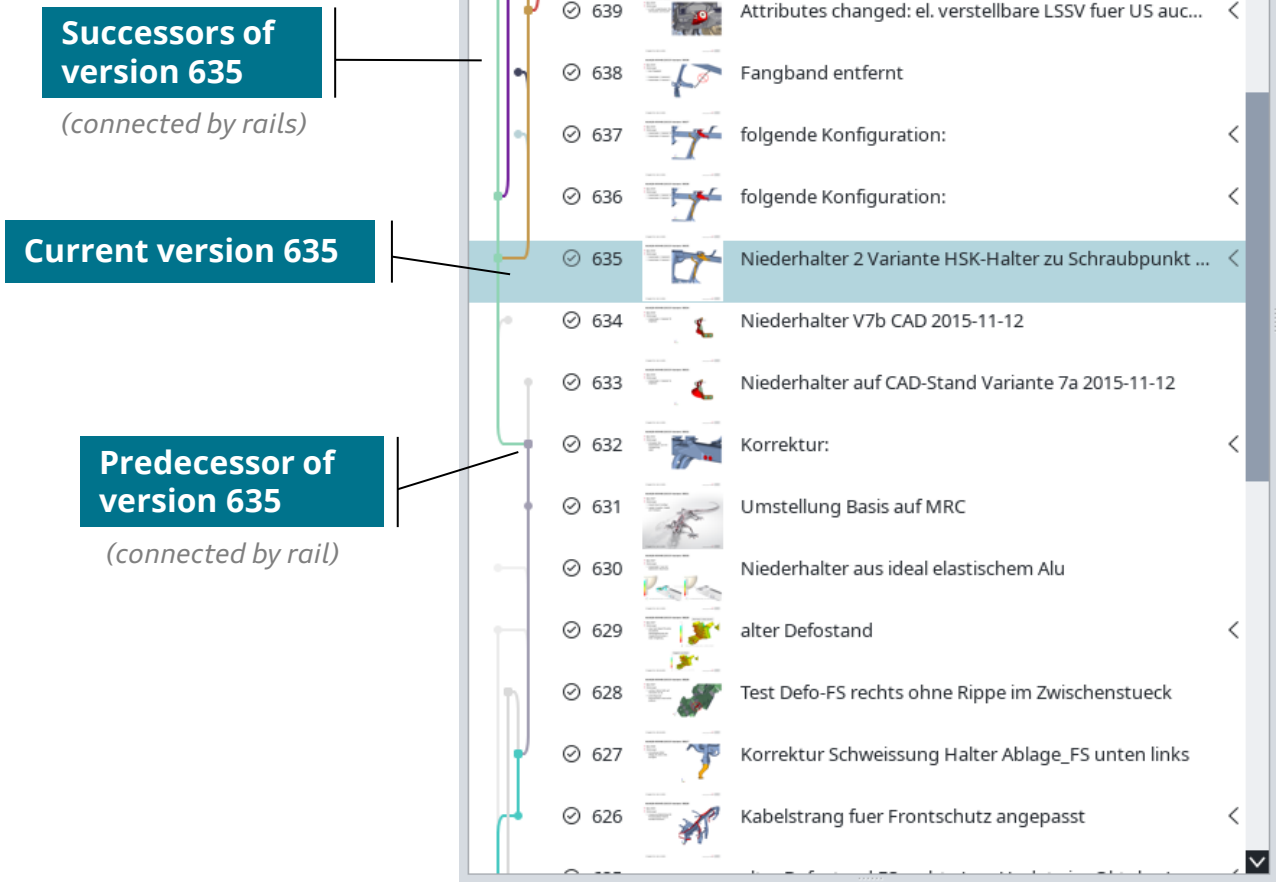
Collaboration

teamwork with many engineers

- **Traceability** by version control
  - Each change automatically documented
  - Completely traceable history
  - Versions are unique
    (can be used for identification and communication)

- Data synchronized between CAE engineers
  - Each change is instantly available for everyone
  - No handling of files in file system
    (no manual up- and download of data)

- Live Mode
  - Collaboration across the world in real time
  - Simultaneous working on different components in one model
  - Each change is instantly propagated to the team
  - Automatic locking of files being worked on



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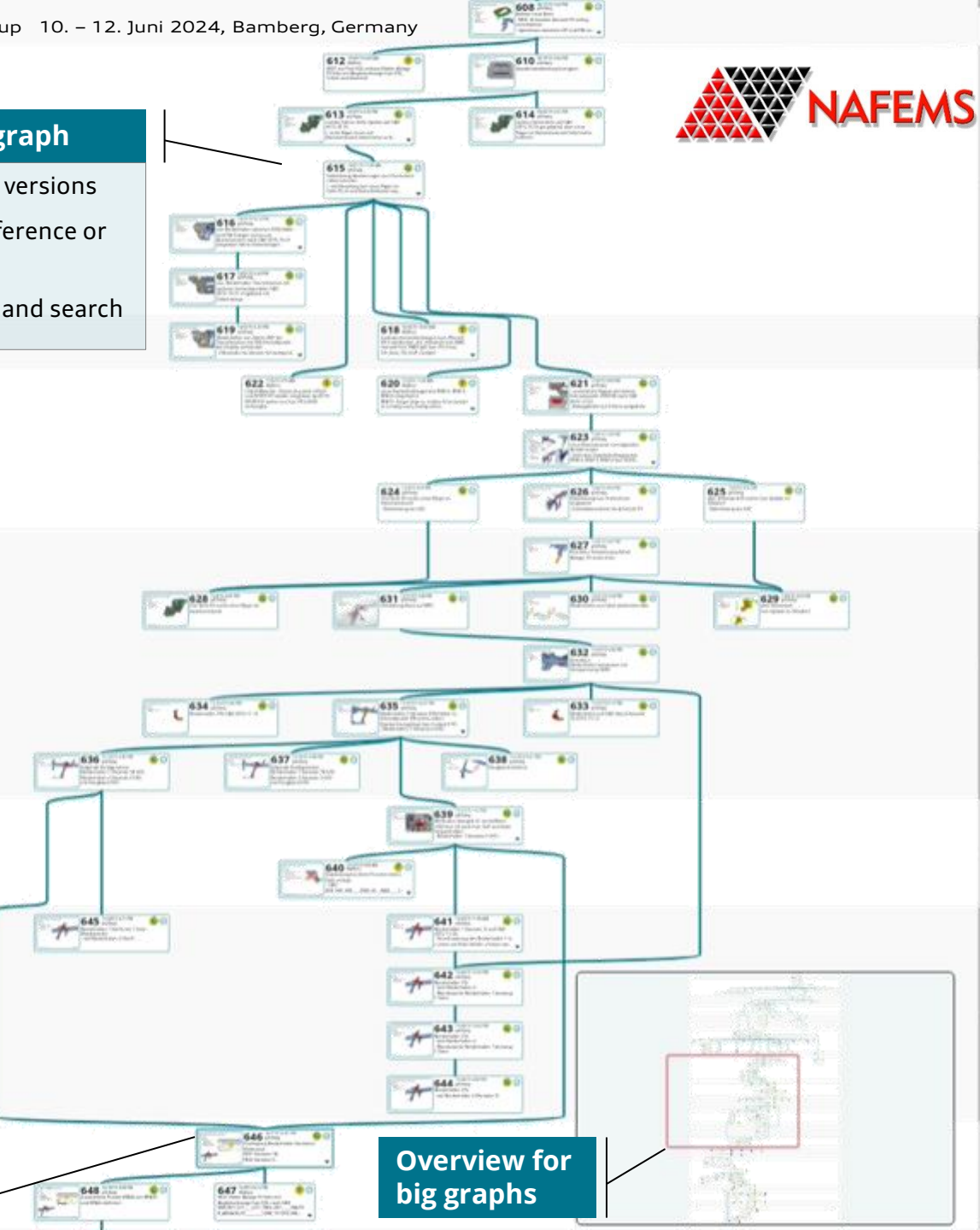
Detailed history graph

- Overview for many versions
- Visualization of reference or status versions
- Advanced filtering and search



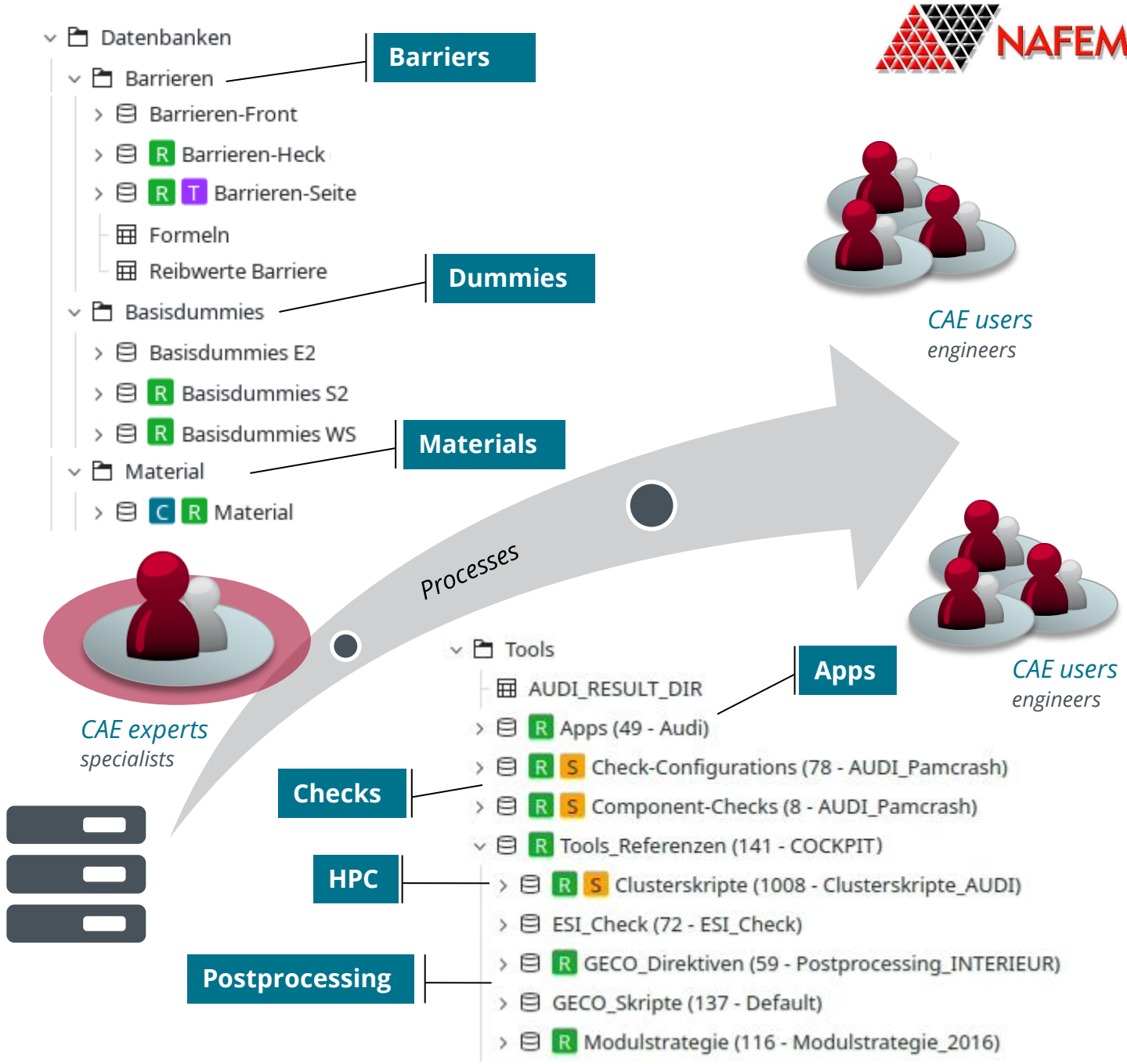
Merged versions

Overview for big graphs

Data structures

project structure with shared data

- Data shared across multiple brands
  - Organized in library pools
  - Can be mounted by any project
- Standardization
  - Assures comparability between projects
  - Reduces errors
- Democratization / knowledge transfer
  - Experts prepare models and methods
  - Every CAE engineer can access and use the provided libraries



Data structures

automatic creation of many load cases from many components

NAFEMS

Component pool

(~500-1000 components in one pool)

Component parameters

airbag TTF	1.0mm
vent area	
sheet thickness	...
calc time	
friction	1.4mm

Assembly of multiple load cases and derivates

(~200-300 run-configurations for one vehicle derivate)

Limousine

Avant

Setup of optimizations and DOEs

- Parameters and optimization goals are defined
- Assembly of vast amounts of simulations

System integration

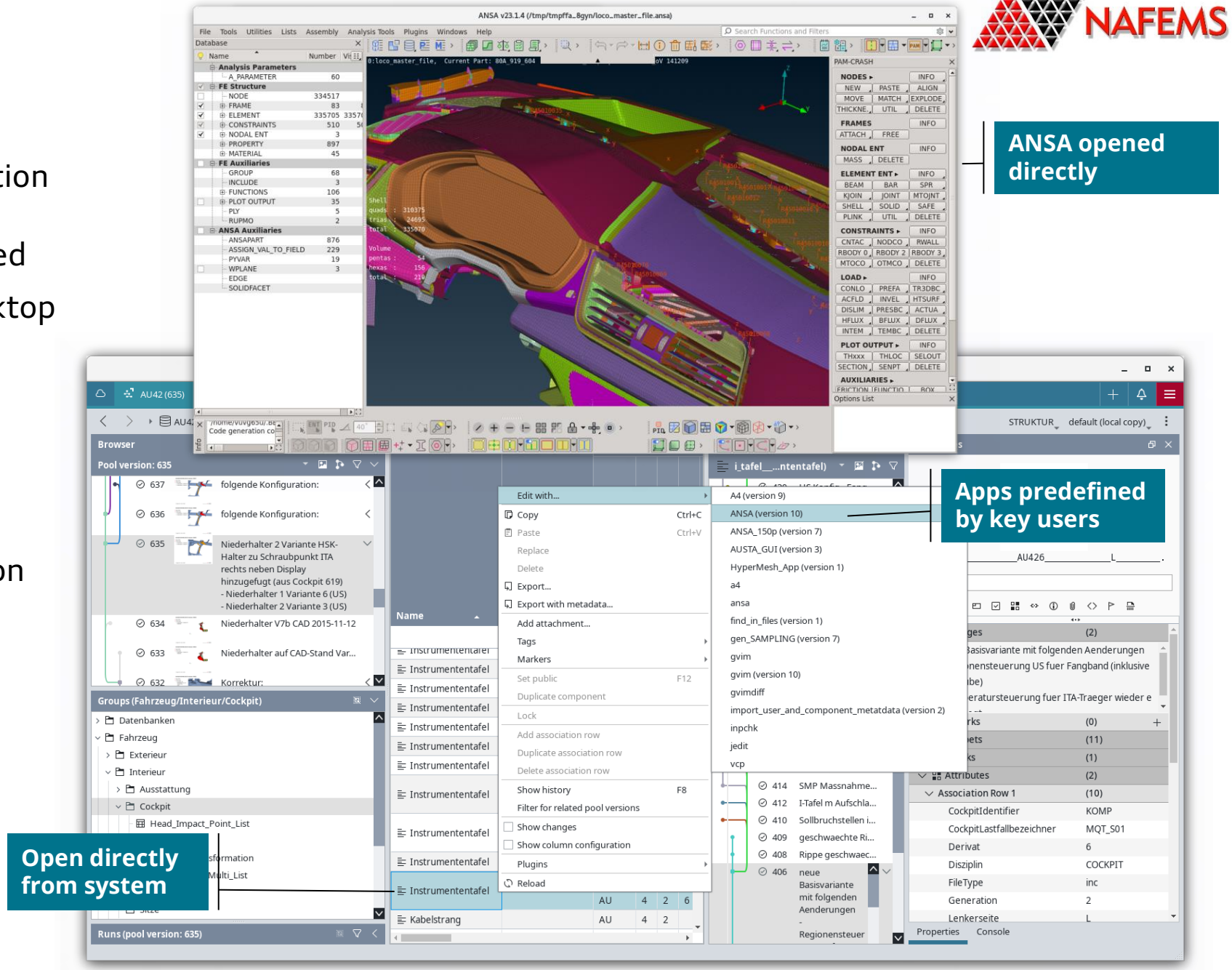
tools and scripts

CAE – Preprocessing tools

- Open directly on local workstation
  (no cumbersome up- and download of files)
- Data automatically synchronized
- Use native applications on desktop
- Python scripting API
- Apps managed by key users

Solver disciplines

- Flexible setup and Configuration
  (completely manageable by advanced users)
- User scripts for
  pre- and post-processing
- Python templates
  for assembly



System integration

model quality assurance through checks

- Errors need to be detected as early as possible!

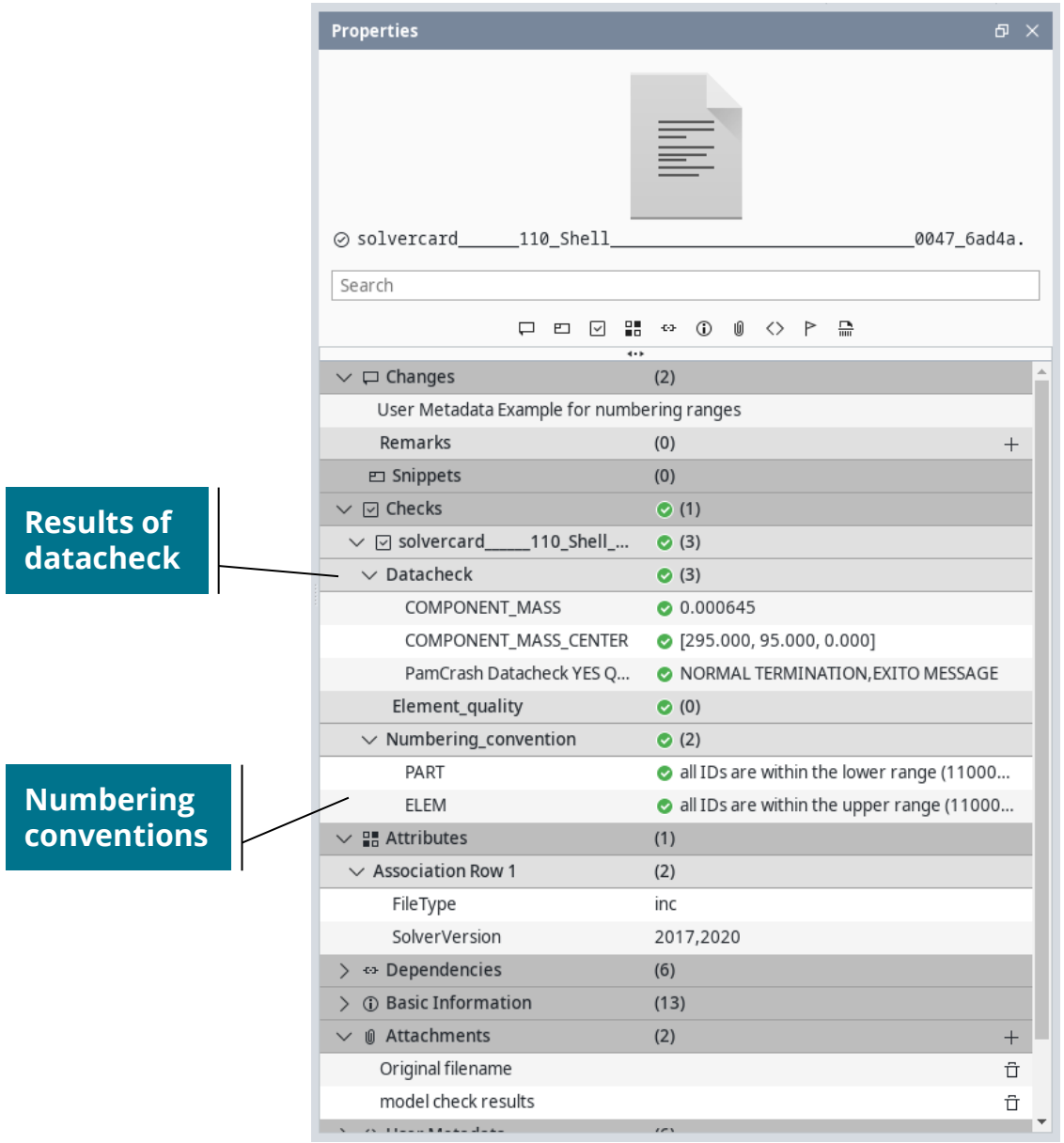
- Checks can be implemented for:
  (implementation as scripts maintained within the system)
  - Individual files
  - Simulation runs

Files

- Can be executed directly after each edit
- On the local desktop or through the HPC
- For a single file only or in the context of a simulation
  (e.g. datacheck of single file)

Simulation runs

- Run during job submit before solving phase starts
- Results are displayed in LoCo
- Reports of checks *(e.g. PDF)*



System integration

submission of simulation jobs to HPC systems

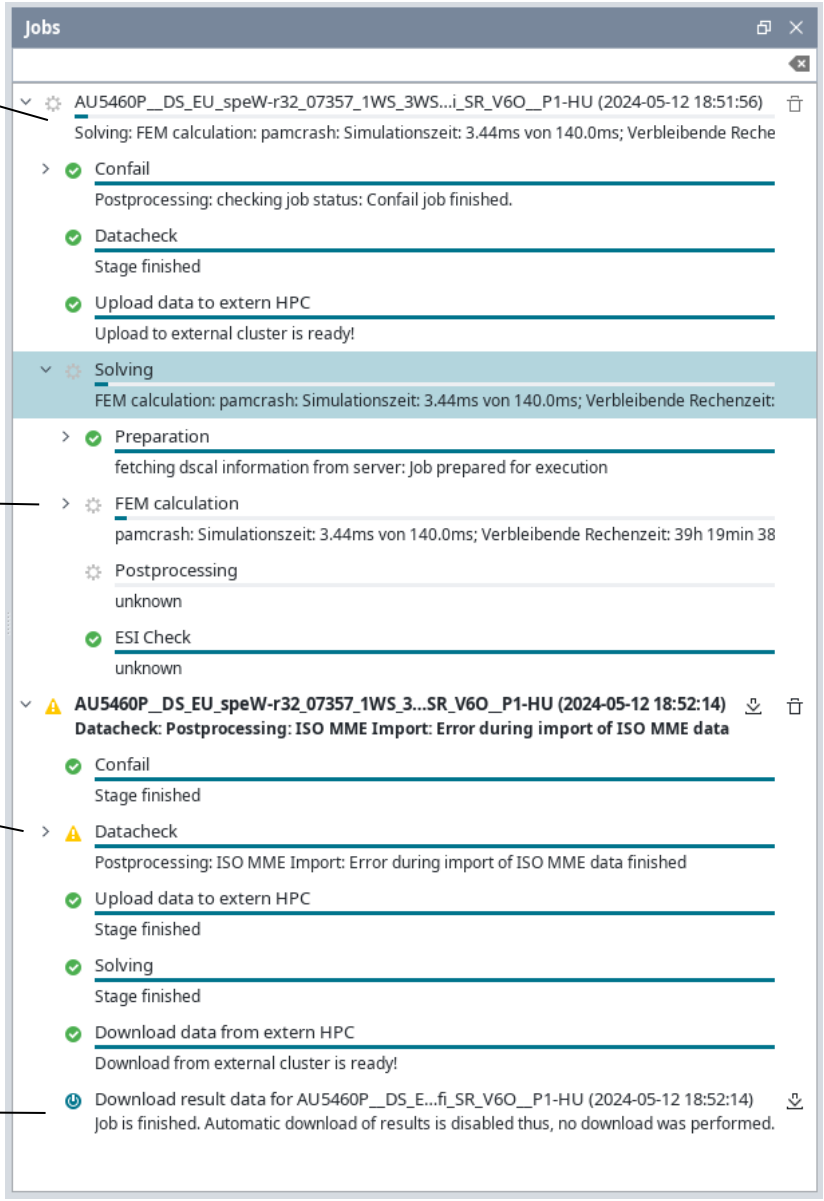
- Job submission
  - Directly from desktop client
  - Solver and queuing parameters
- Queuing system
  - Starting and killing of jobs
  - Multiple different HPC systems on different locations with different queuing systems can be integrated
- Progress feedback
  - API for creating feedback for every process
  - HPC scripts can provide progress feedback independent of server infrastructure
  - Progress feedback for complex simulation jobs
    (helps users in case simulation jobs are running into problems)

Progress of running simulation job

Detailed progress of each step in the simulation process can be inspected

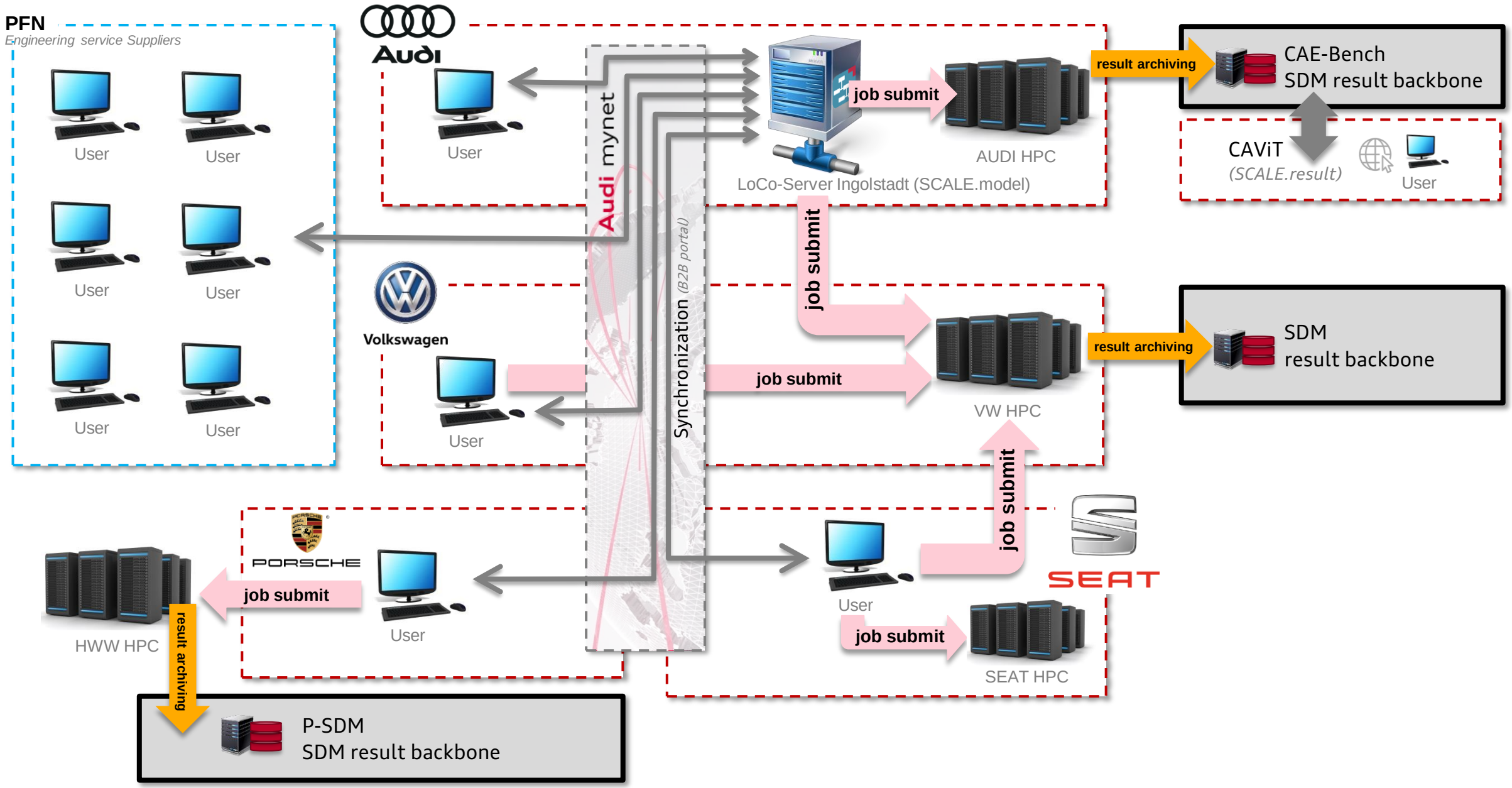
Datacheck job finished but had some problems

Results can be downloaded to local workstation



System Integration

IT architecture and archiving of simulation results



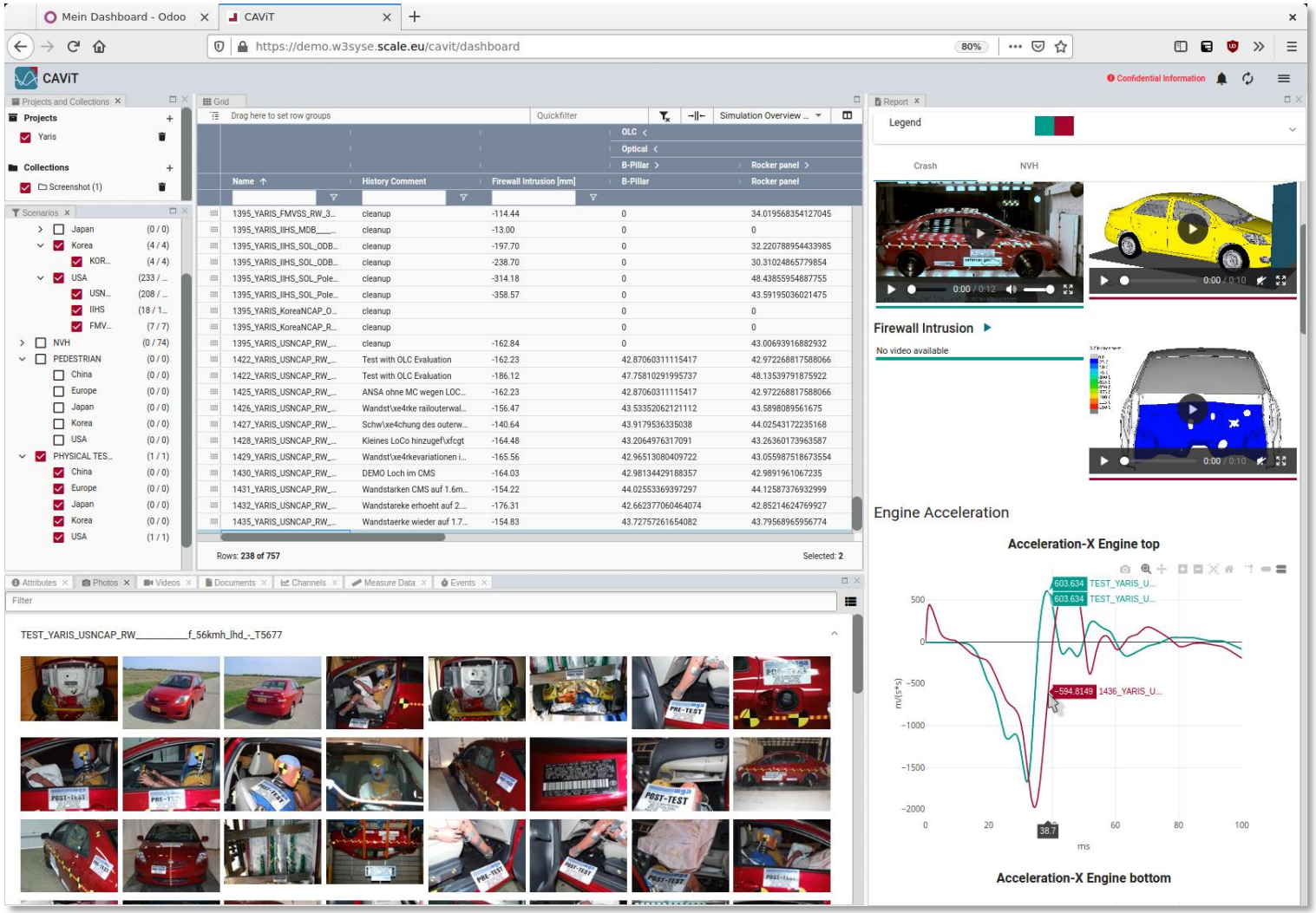
Summary & outlook

Summary

- Increasing demand for CAE
- SDM essential
  - Collaborating with many engineers
  - Enforcing standardization
- Usability and performance are the most important factors

Outlook

- Further performance optimization
- Tight integration with Results
  (CAViT | SCALE.result)
- Cloud
- Machine Learning
  - Event Detection
  - Data Analysis
  - ...



Thank you!