SDM-Solutions for Crash Simulations

Experience in Software Implementation

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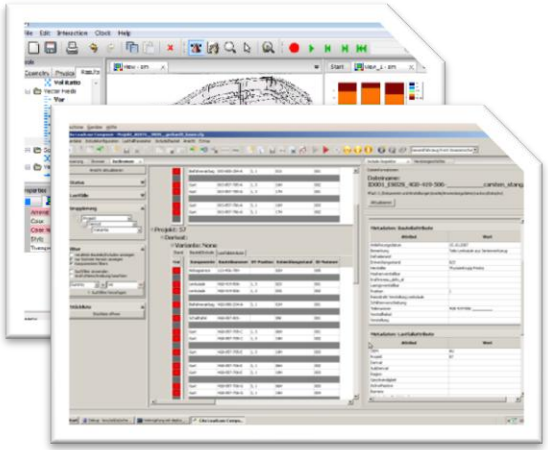
Branch Office in Dresden

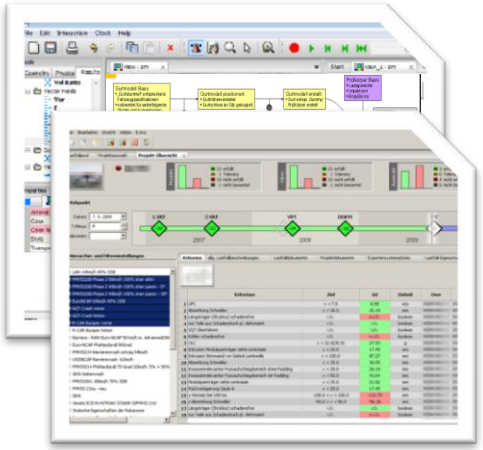
Branch office in Dresden…

- Since 2008
- Area: Software Engineering / Process automation / …
- Team comprising of computer scientists and Engineers

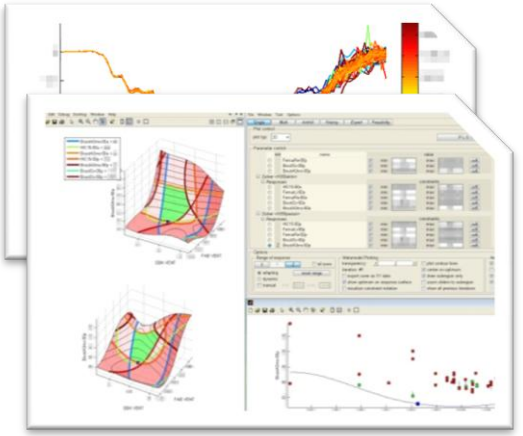
SDM-Solutions



Processa…/Monitoring



Analysis/Optimiza…



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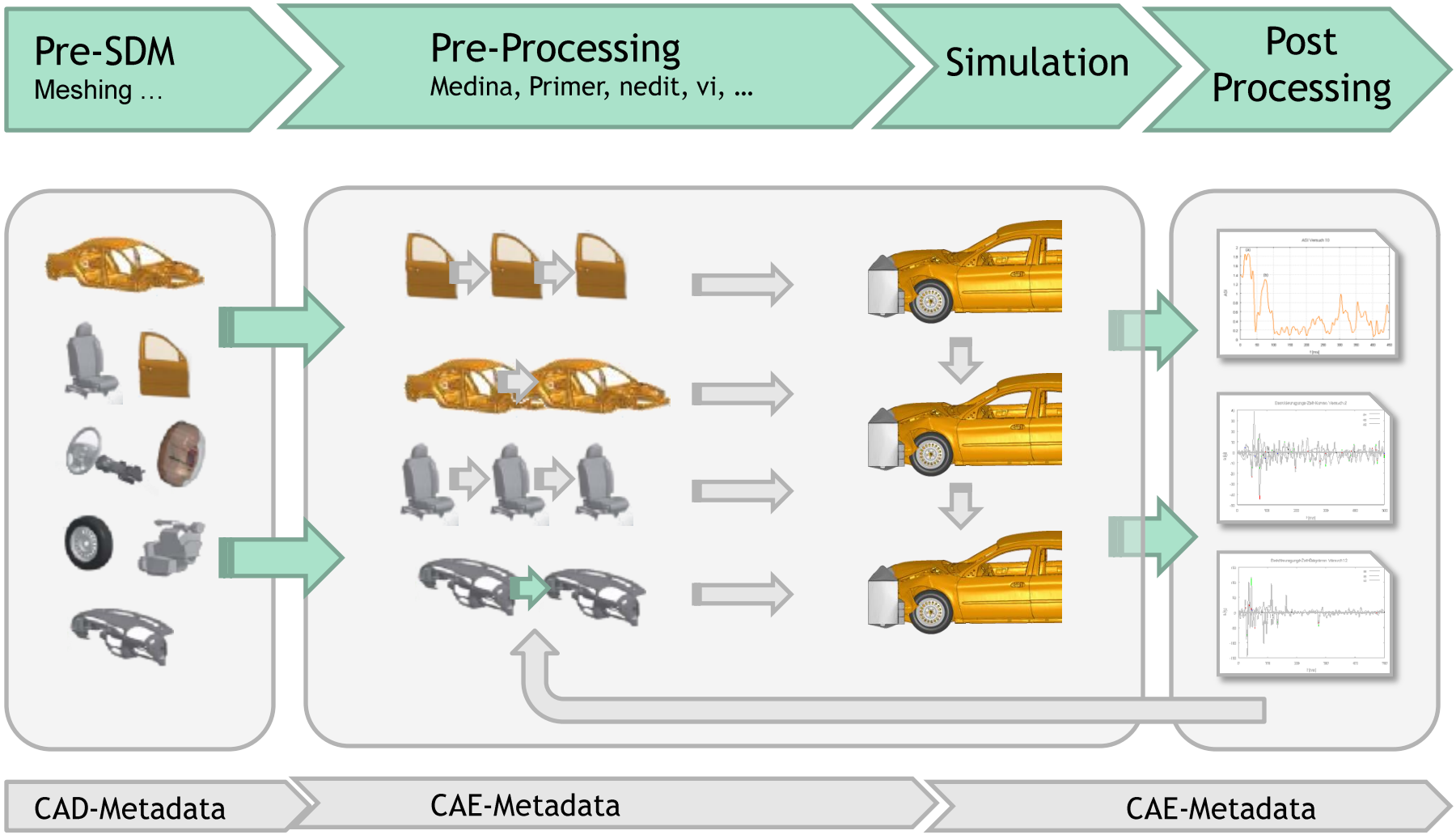
SDM-Solution - Integration into the overall process



Development of models for crash simulations

…a few years ago

- One monolithic model
- Few load cases
- Very little variant investigations, optimization etc.

Today…

- Variety of load cases
- Frequent optimization and design variations
- Numerical simulations including basis for component approval
- No monolithic decks – breakdown in sub-models
- Teamwork
- Assembly of a specific input deck on demand
- Many load cases
- At the same level of development: Availability of parallel models for different solvers

Objectives of SDM Solution

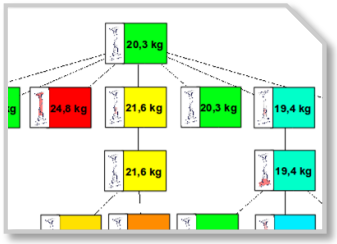
Objectives…

- To facilitate e.g. Definition of a single work process.
- Automation of work processes
- Coherence and quality of the project data: Integragted content and timely documentation of processes
- Co-optimization; project- and interdisciplinary sharing of common parts
- Synchronus data distribution to project participants

Target groups…

- CAE Engineers
- Project Managers

Aspects of SDM solutions



Model management and -documentation

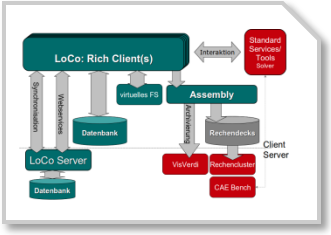
Includes data, Sub-models…
Metadata, History

Generation of complete model / Assembly

Assignment, Scenarios, Attributes etc.
Assembler, Templates

Team work

Data sharing, Local cache, Offline/Online working
Flags, Status, …



IT-Integration

Tools, Optimization support
CAE-Bench, Status monitoring

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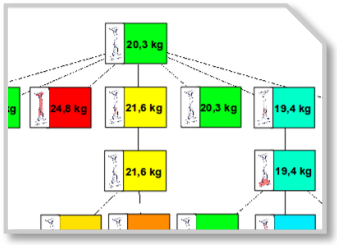
Aspects of SDM solutions



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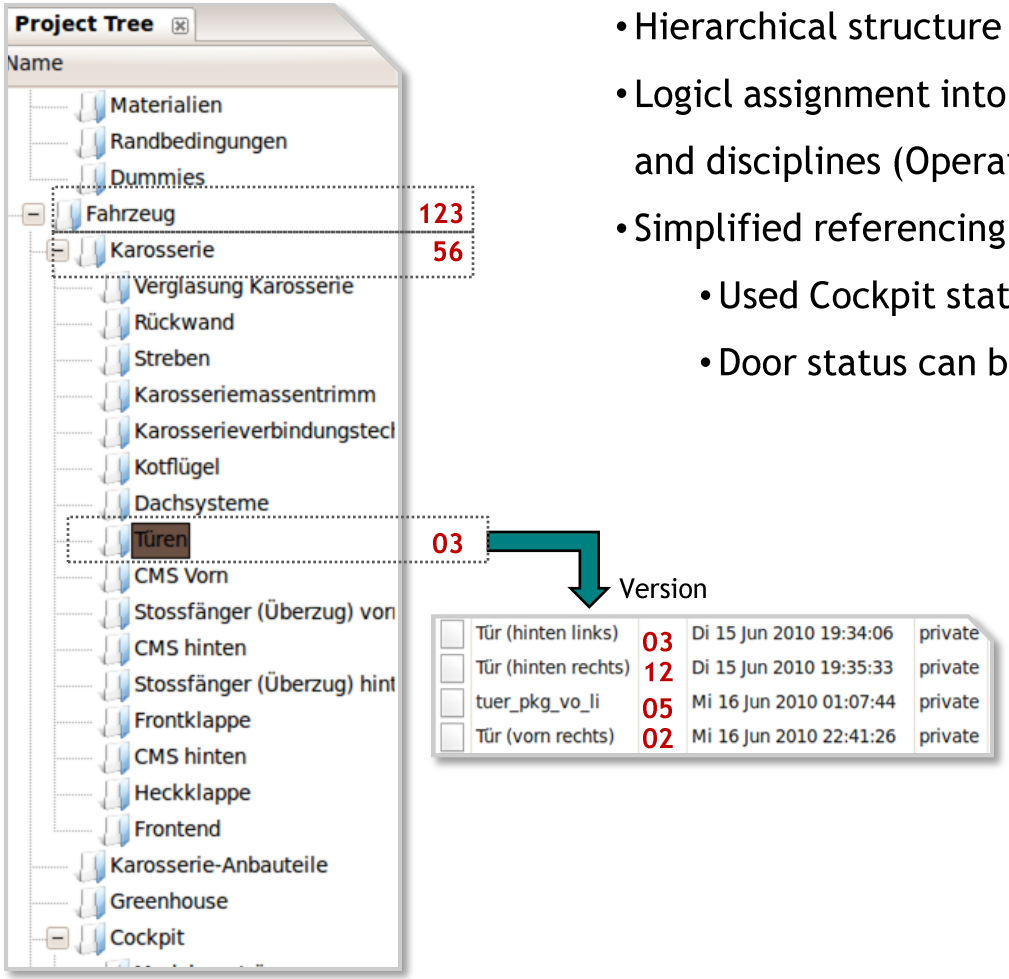
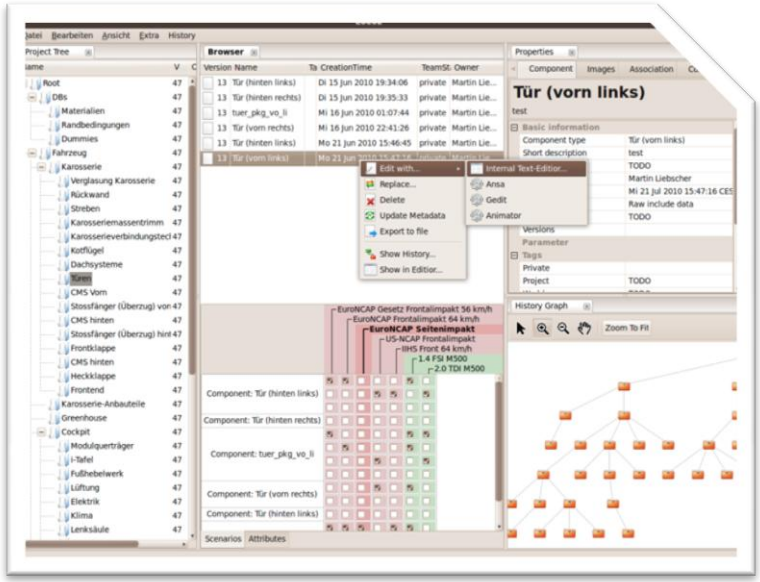
Model management and -documentation

Logically configurable structure

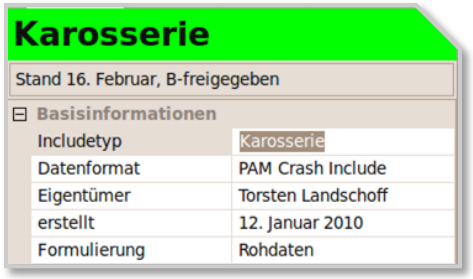


- Hierarchical structure of the complete vehicle
- Logicl assignment into groups according to the fucntional Aspects and disciplines (Operating department)
- Simplified referencing /Handling
  - Used Cockpit status 83, Door status 03 etc.
  - Door status can be treated as an include

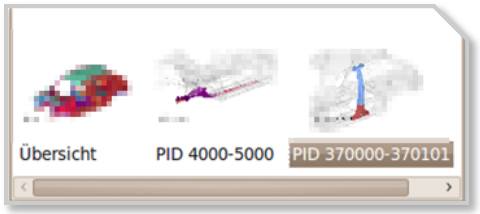


Model management and -documentation

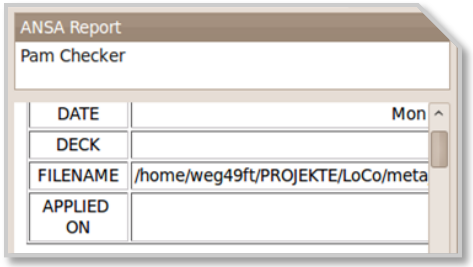
Maintenance of Basic Information



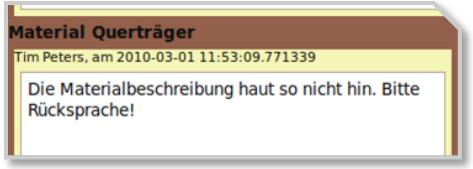
- Creator, Timestamp, …
- Development status, Predecesor
- Submodel type (Solver/Formulation)
- Parameterization (which parameter, which default value)



- Automatic generation of previews
- Highlighted modified geometry/parts



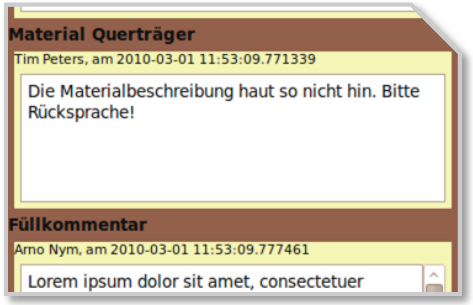
- Generation of reports as additions
- Addition of Documents (PPTs, DOCs usw.)
- Addition of data source e.g. ANSA Data



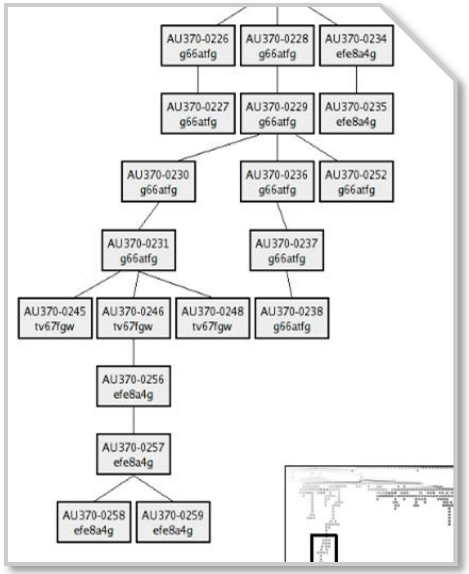
- Annotations on the development status
- Changes compared to the version

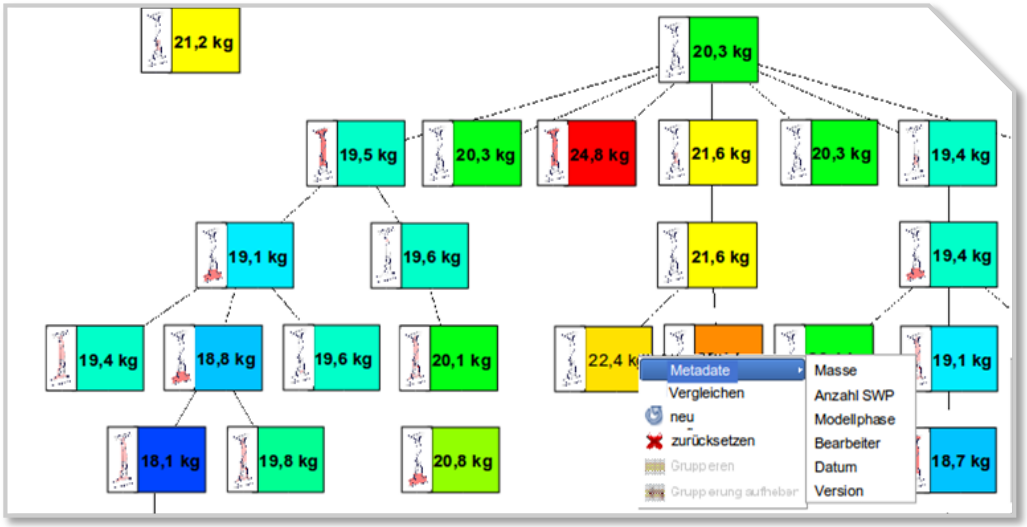
Model management and -documentation

Tracking of changes / History



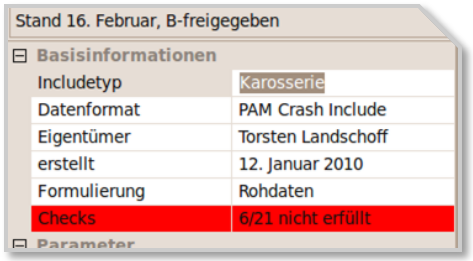
- Comment history
- Graph of the predecessor / successor (all versions)
- Several predecessors/successors, especially through team work possible (at the same time)
- Tracking of changes to model parameters (e.g. Mass)
- Overview of Geometry changes (what changes where)

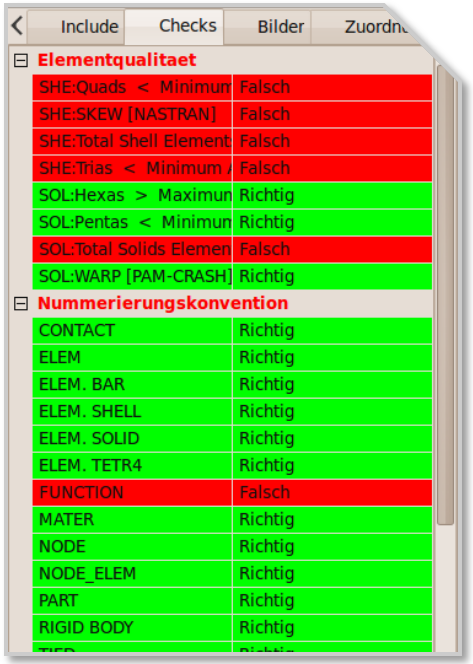




Model management and -documentation

Quality Assurance





- Calculation of the quality index after each update
  - Enforce checks for numbering
  - Element quality
  - Prediction of timestep / timestep limit
  - ...
- Sub-model evalation

Critical

Acceptable

Ok

- possible disabling of the partial model for specified actions, e.g.
  - May not be used in a simulation model
  - May not have special status / obtain approval
  - ...

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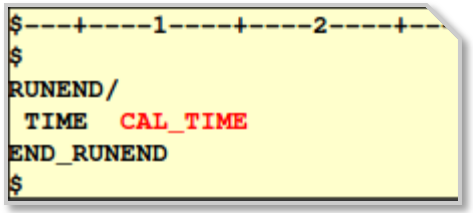
Model management and -documentation

Parameterization

- Identification of parameters during update of a sub-model

  Parameter can be e.g.:

  - Ignition points
  - Impact points
  - Sheet thickness
  - Material properties
  - …



- Parameters are defined, based on placeholders and/or in solver specific format in Inlcude (before updates)
- Pre-definition of mandatory parameters is possible
- User defined parameters
- Provision of default values

Aspects of SDM solutions

Model management and -documentation

Includes data, Sub-models…
Metadata, History

Generation of complete model / Assembly

Assignment, Scenarios, Attributes etc.
Assembler, Templates

Team work

Data sharing, Local cache, Offline/Online working
Flags, Status, …

IT-Integration

Tools, Optimization support
CAE-Bench, Status monitoring

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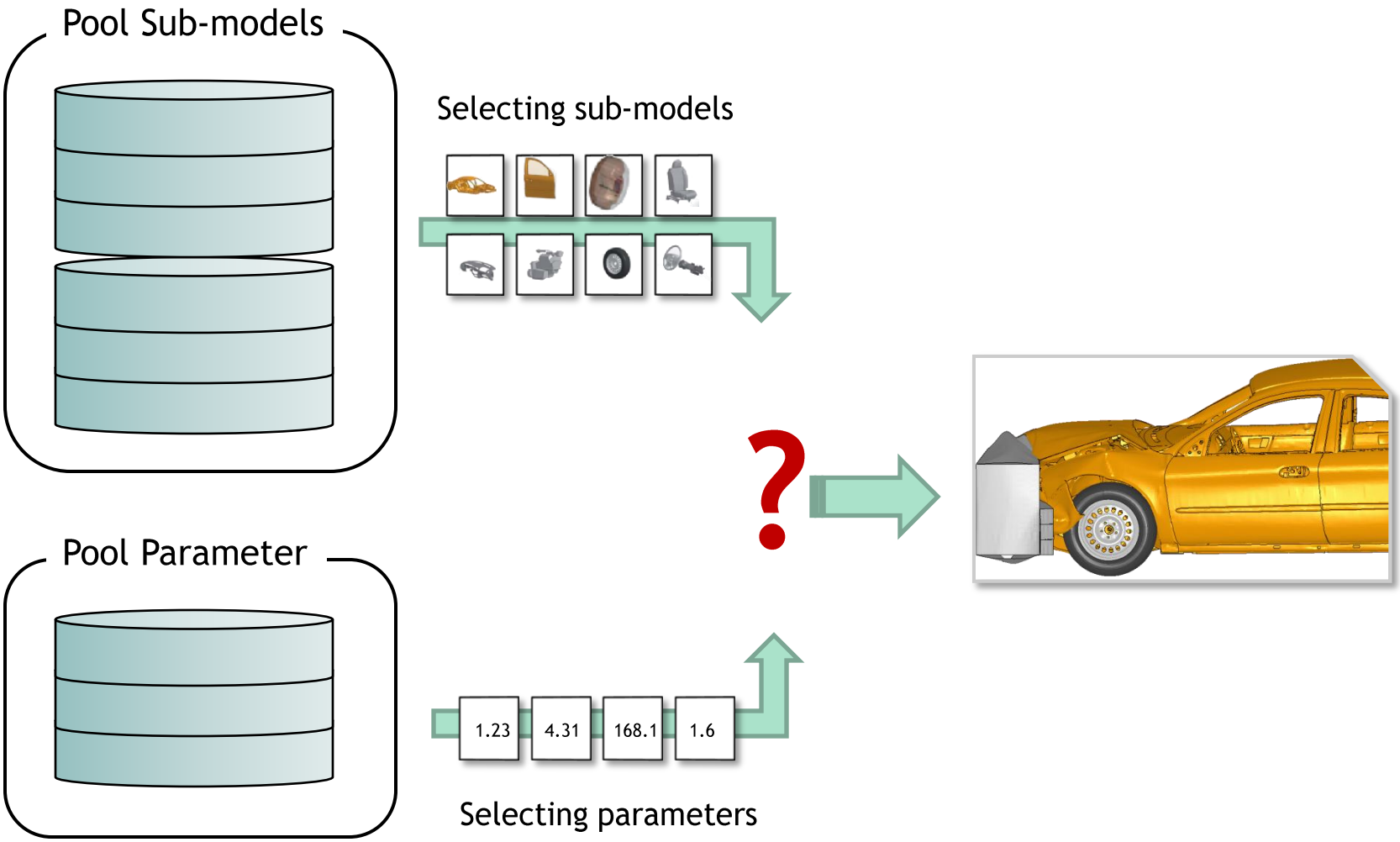
Generation from Simulation models (Assembly)



Generation from Simulation models (Assembly)

Sub-model assignment – Attribute based

Pool





Region	Zone	Side	Dummy
Europa			

Attribute

- Limits the validity of sub-models
  - Region: EU, US
    sub-modell only for US or EU use cases
  - No Attribute: universally applicable
  - Assignment also possible for the projects (comprehensive project working)
  - Very flexibly applicable
- Possibly complicate for beginners

Generation from Simulation models (Assembly)

Sub-model assignment – Scenarios based

Pool





Szenario (Load case)
Euro NCAP Front, Side, …
US NCAP Front, Side
Euro NCAP Front (Driver)
Euro NCAP Front (Passanger)
Euro NCAP Front (Driver)
Euro NCAP Front (Passanger)
Euro NCAP Side (Driver)
Euro NCAP Side (Driver)

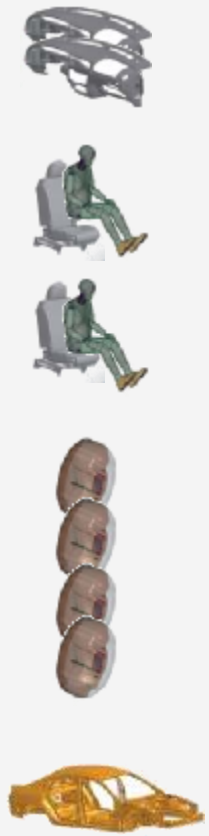
Scenarios

- Limits/reduces the validity of sub-models
- Commonly spoken labels; beginner friendly
- Flexibility is somewhat limited
- If necessary, many scenarios (all load cases, vehicle configurations etc.)
- Mapping by scenarios, possibly complex (Useability)

Generation from Simulation models (Assembly)

Sub-model assignment – Attribute and scenarios applicable in parallel

Pool



Region	Zone	Side	Dummy
Europa			
USA			
	Front	Fahrer	H3 50%
	Front	Beifahrer	H3 50%
	Front	Fahrer	
	Front	Beifahrer	
	Seite	Fahrer	
	Seite	Beifaher	

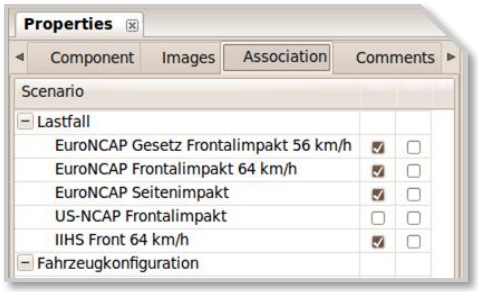
Szenario (Load case)
Euro NCAP Front, Side, ...
US NCAP Front, Side
Euro NCAP Front (Driver)
Euro NCAP Front (Passanger)
Euro NCAP Front (Driver)
Euro NCAP Front (Passanger)
Euro NCAP Side (Driver)
Euro NCAP Side (Driver)

Generation from Simulation models (Assembly)

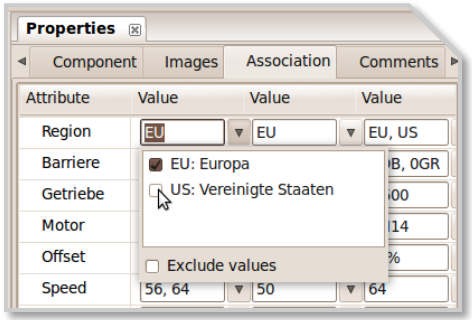
Sub-model assignment – Attribute and scenarios applicable in parallel

Pool

Euro NCAP Front = Region: Europe
Zone: Front
Dummy: H3
…

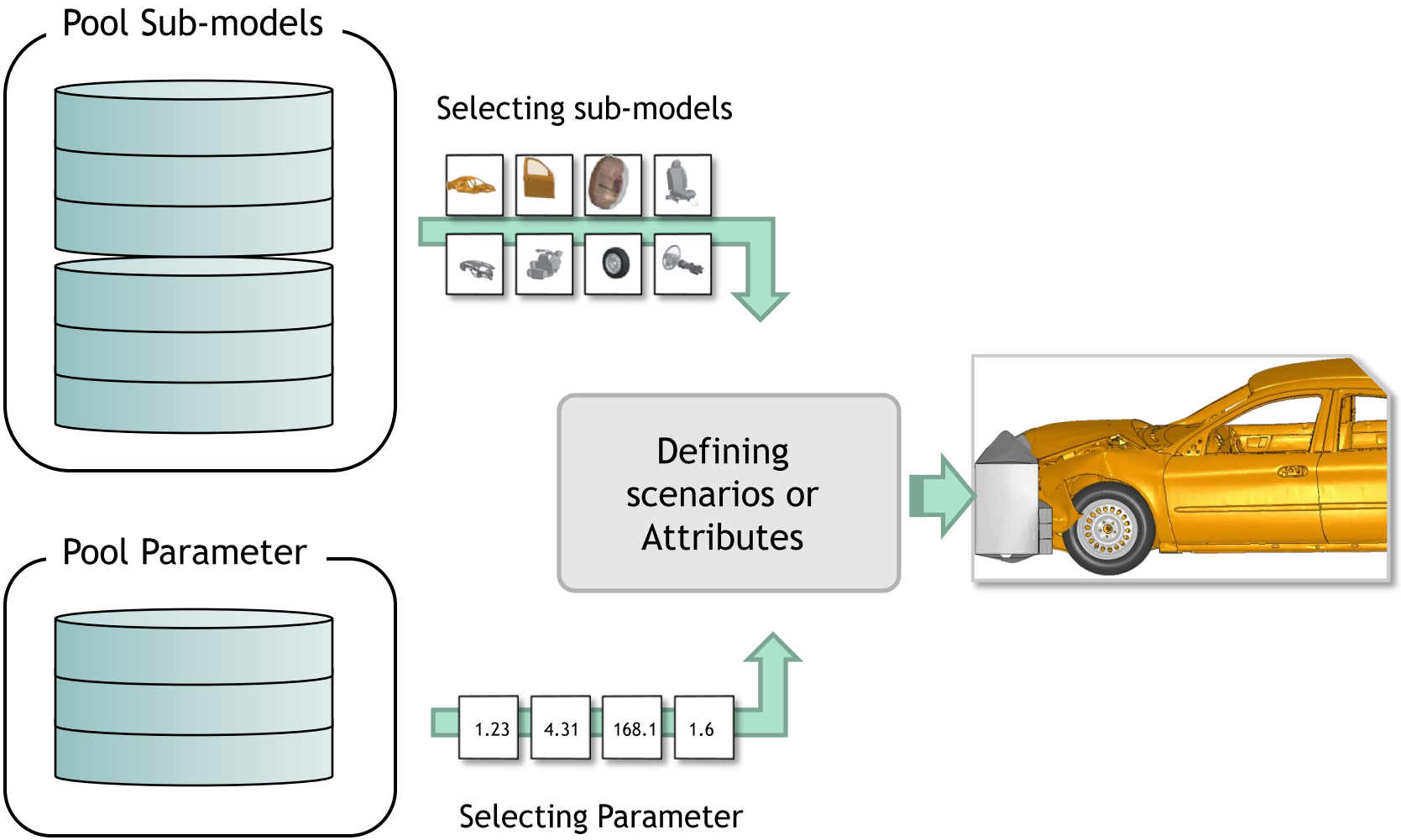


Euro NCAP Side = Region: Europe
Zone: Side
Dummy: H3
…



- Attribute representation / scenario representation interconvertible
- ..so that the application of both the cases is possible at the same time and can be swaped anytime

Generation from Simulation models (Assembly)



Generation from Simulation models (Assembly)

Software implementation/realization of the assembly process

Objective: uniform assembly process

- Partly very different requirements in departments
- Isolated special cases

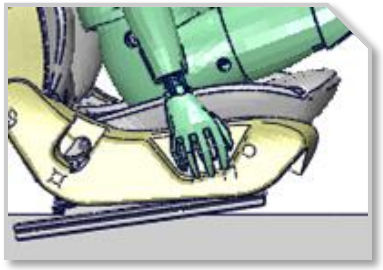
Multidisciplinary use / Acceptance is only possible when all requirements can be fulfilled

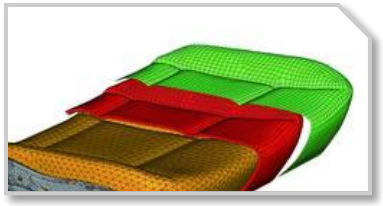
Flexible: Template based approach

- Deployment of assemblers for 90%-coverage of the requirements
- Assembler easily customizable via Templates – no new software release required; less dependence on the software house
- Key-User can extend/adapt the Assembler independently
- Template-based language provides very primitive commands; is freely extendable, thereby powerful

Generation from Simulation models (Assembly)

Extended possibilities of template based assemblers





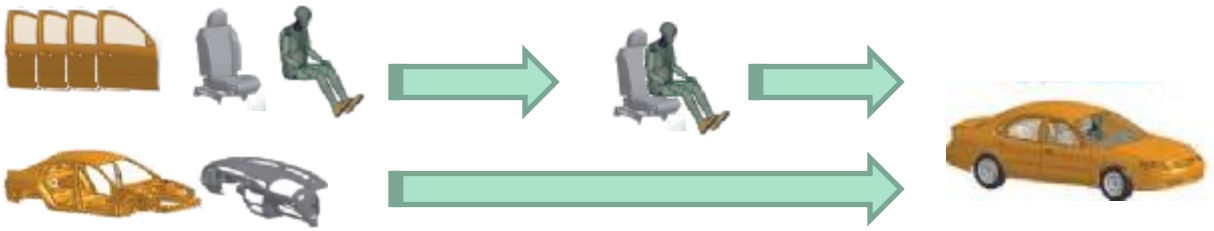
Update and Management of Seat, Belt und Dummies solely as base model versions

•Occupant and seat positioning is initialized by the assembler when assembling

•Specific Dummy-Belt-Seat sub-model is used in the overall simulation

Assembly

Selecting sub-models → Flow calculation → Overall Model



Aspects of SDM solutions

Model management and -documentation

Includes data, Sub-models…
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Flags, Status, …

IT-Integration

Tools, Optimization support
CAE-Bench, Status monitoring

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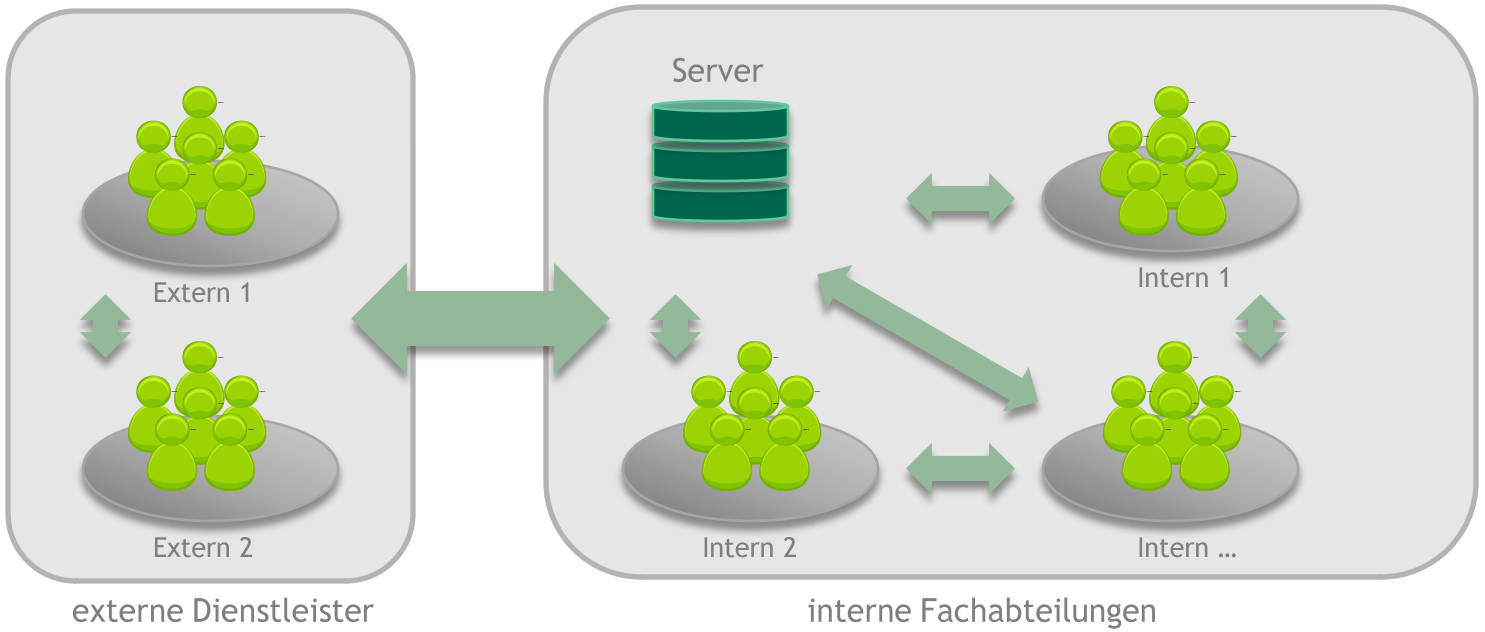
Teamwork - Synchronisation Intern, Extern, Teams…



Sync
Centralized/
Decentralized

- Centralized data handling and synchronisation with central server (potential bottleneck); Server data status is the reference data set
- Decentralized synchronisation is also possible between the teams and within the teams

Offline/Online
Working

- Offline processing of the data (Rich Client) – person/teams are independent from server; aviods bottleneck and increases performance through lokal caches of data
- Internal/external transfer of data over Webservices (Standard protocols http/https)

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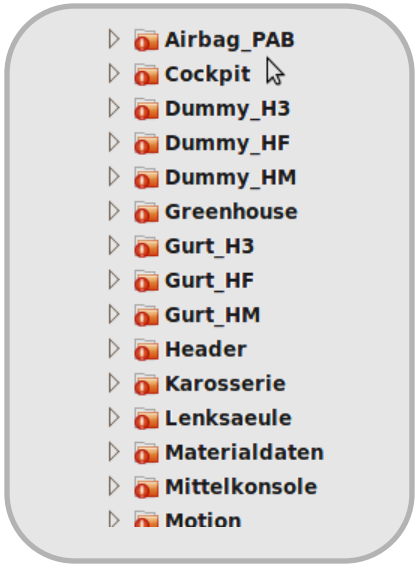
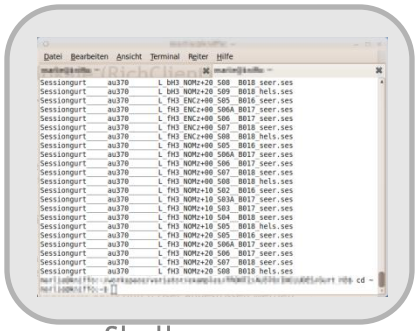
Teamwork - local Data Storage (Rich Client)

Possibility: Local data storage (cache) in file system



... in File system



... Shell

Pros

- Low threshold, little change in the operation for the CAE Engineer
- Access using OS tools (Terminal, File browser etc.)

Cons

- Data integrity must be constantly verified; Changes outside the application should be monitored;
  Data integrity cannot be ensured
- Performance not optimal (due to constant scanning, monitoring)
- Management of metadata is problematic

Data storage in the file system is not optimal

Teamwork - local Data Storage (Rich Client)

Possibility: Local data storage (cache) in database

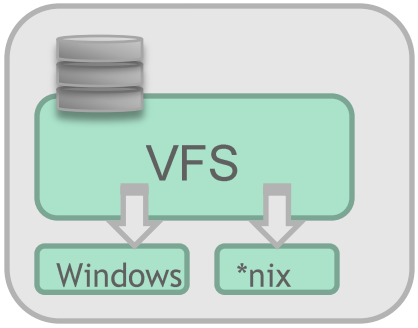
… in Database

Pros

- Performance
- Data integrity ensured
- Efficient management of Metadata is possible

Cons

- No direct access, only using application
- (particularly no access over file system)

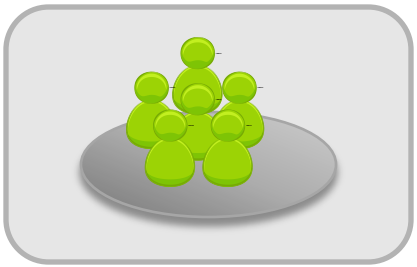


… virtuelles Dateisystem

Provides a virtual file systems

- Access is possible in a usual way using OS tools (Terminal, File browser etc.); Performance loss
- Comparable to a mounted network drive
- Data integrity is ensured using VFS

Teamwork - More Features



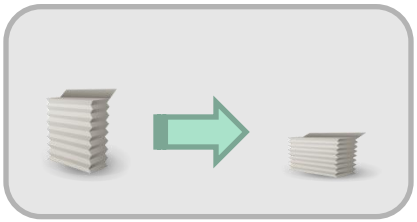
Rights management

- Enabling (read/write) of sub-models / projects / sections for user, user groups
- Private/public status of one‘s own data

Tags

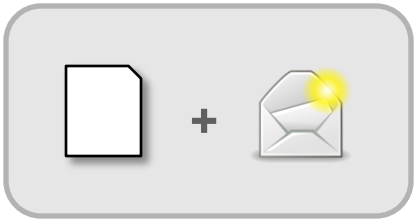
- Highlight data / assignment of properties

Examples: Status variant/Mile stones; obsolete, invalid, ..



Data compression

During the data transfer, only the difference from the previous version is conveyed



News / Comments

Addition of Status-Information to sub-models upon user actions

Aspects of SDM solutions

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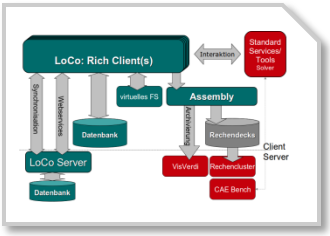
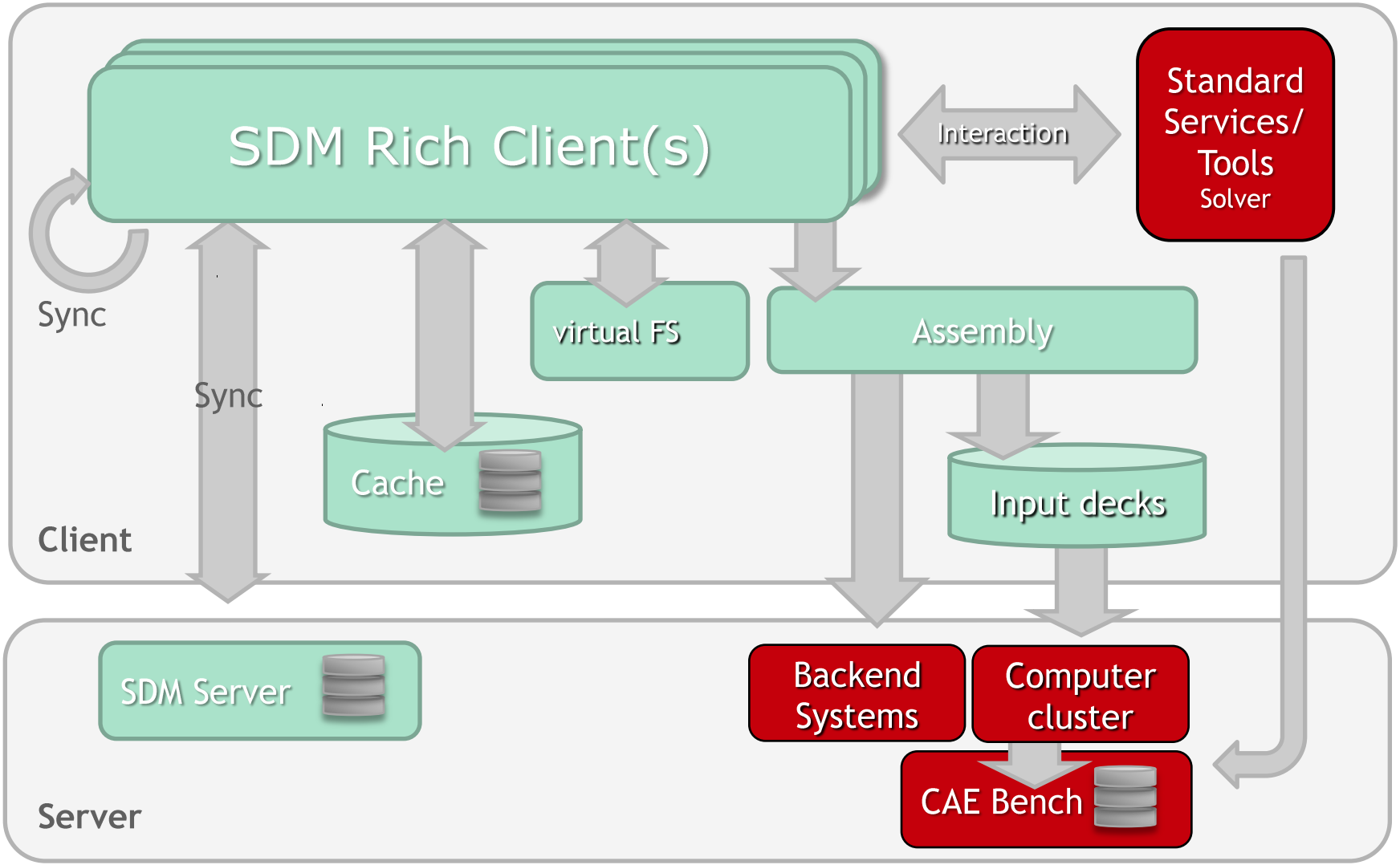


IT-Integration

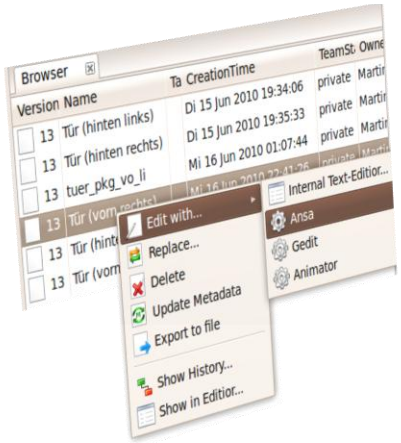
Tools, Optimization support
CAE-Bench, Status monitoring

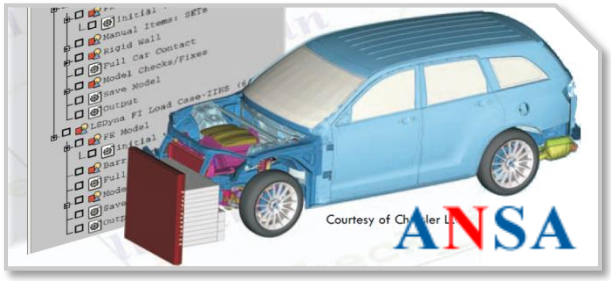
IT-Integration / IT-Concept



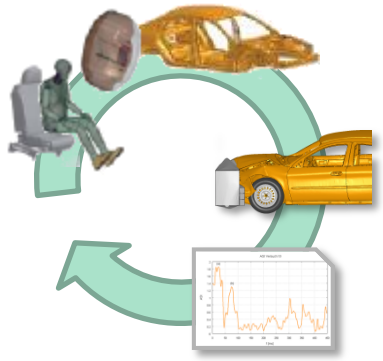
IT-Integration - Linkage Tools

Direct calls to external tools, user scripts, link-up CAE-Bench

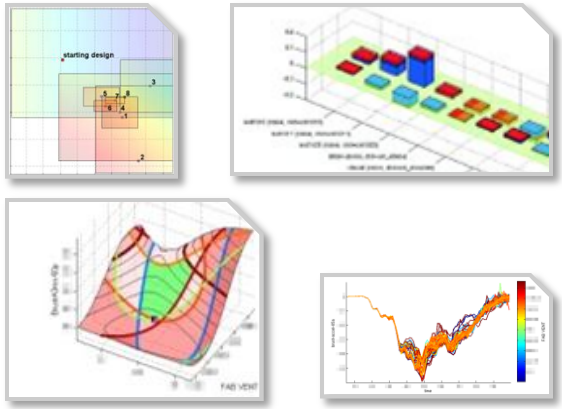




Integration optimization support

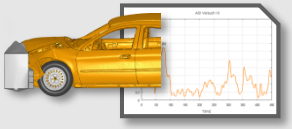


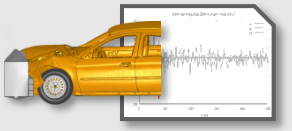
- Models are parameterized
- Simulation models are assembled automatically
- Linkage to Optimization software like LS-OPT

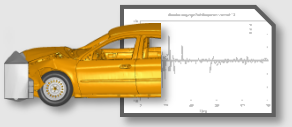


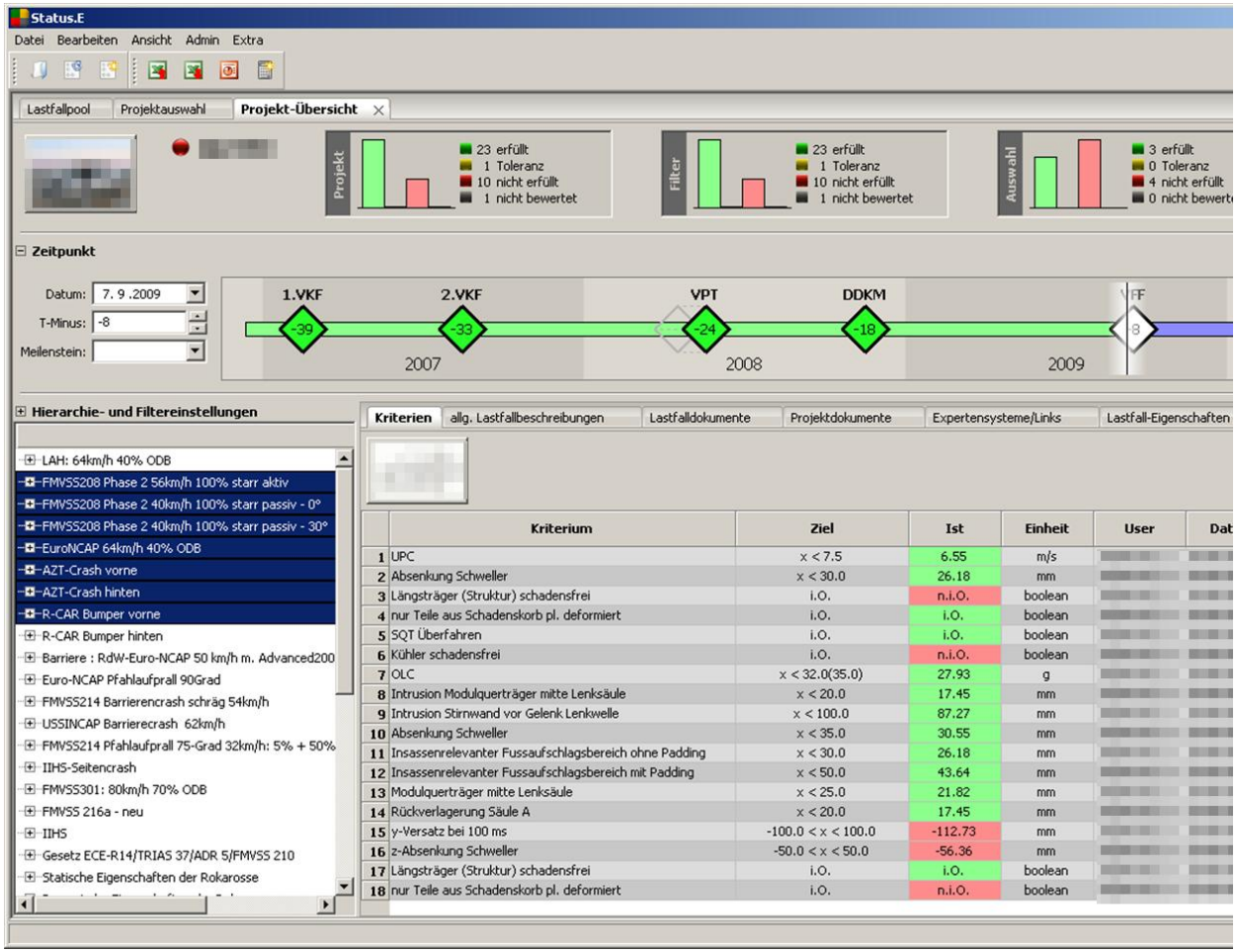
IT-Integration - Linkage Status monitoring

Simulation









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