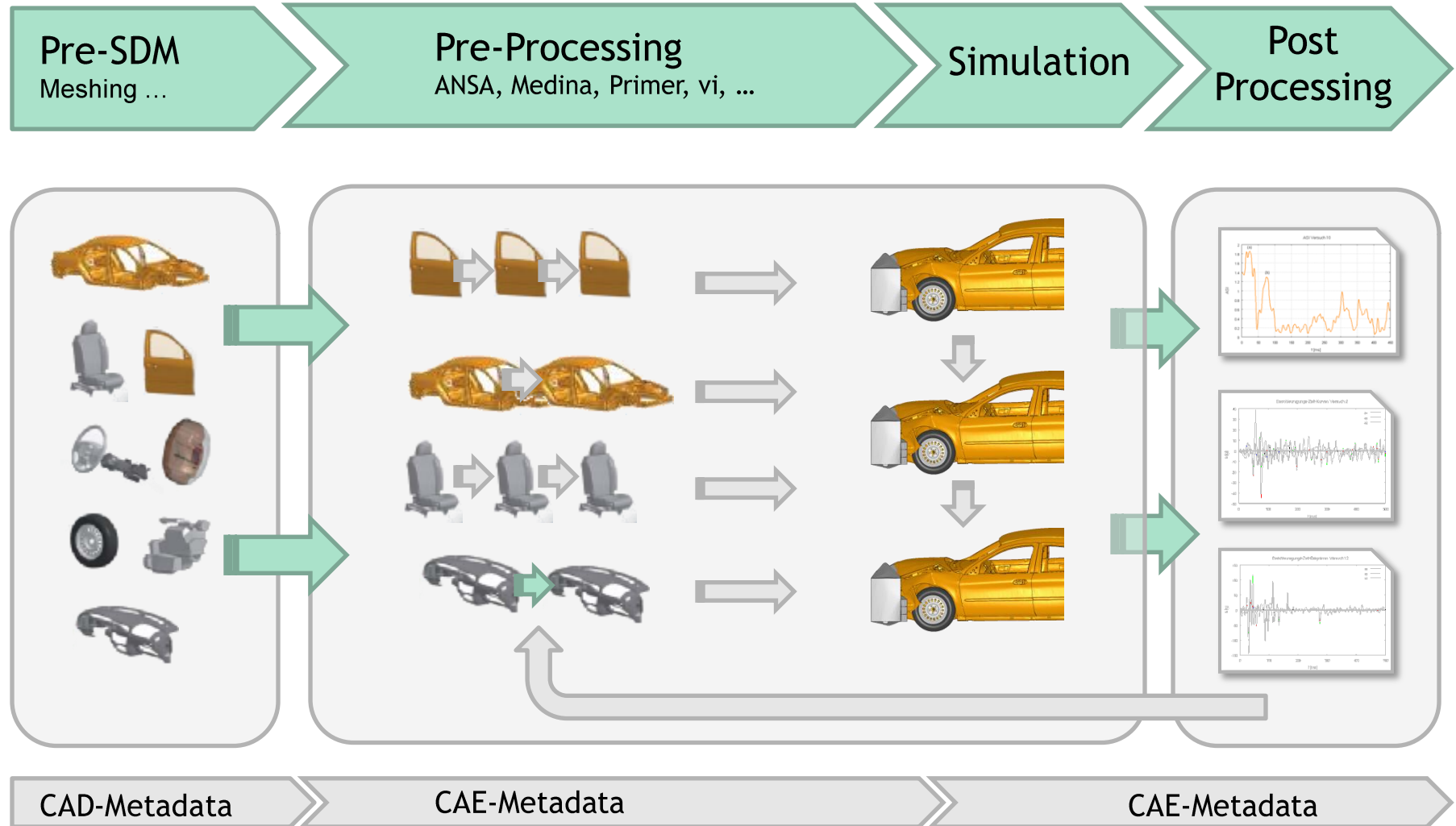


# SDM-Solutions for Crash Simulations

## Requirements in Software Development

Martin Liebscher  
Marko Thiele, Heiner Müllerschön  
DYNAmore GmbH

# SDM-Solution - Integration into the overall process

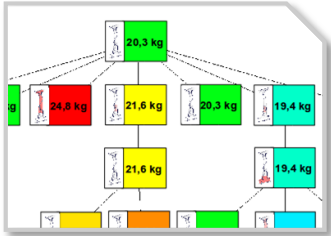


# Objectives of SDM Solution

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- **To facilitate e.g. Definition of a standardized work process**
  - Embedding of established processes
  - Homogenization of processes
- **Automation of work processes**
- **Coherence and quality of the project data:**
  - Integrated content
  - Tracking of changes
  - and timely documentation of processes
- **Co-optimization; project- and interdisciplinary sharing of common parts**
- **Synchronous data distribution to project participants**
  
- **Targeting**
  - CAE Engineers
  - Project Managers

# Aspects of SDM solutions



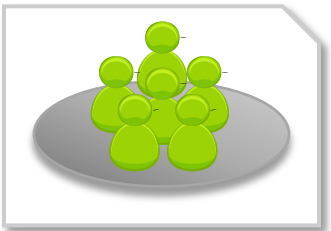
## Model Management and Documentation

Include data, Sub-models...  
Metadata, History



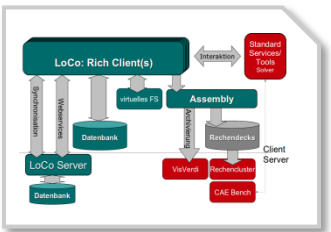
## Generation of complete model / Assembly

Assignment, Scenarios, Attributes etc.  
Assembler, Templates



## Team work / Collaboration

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

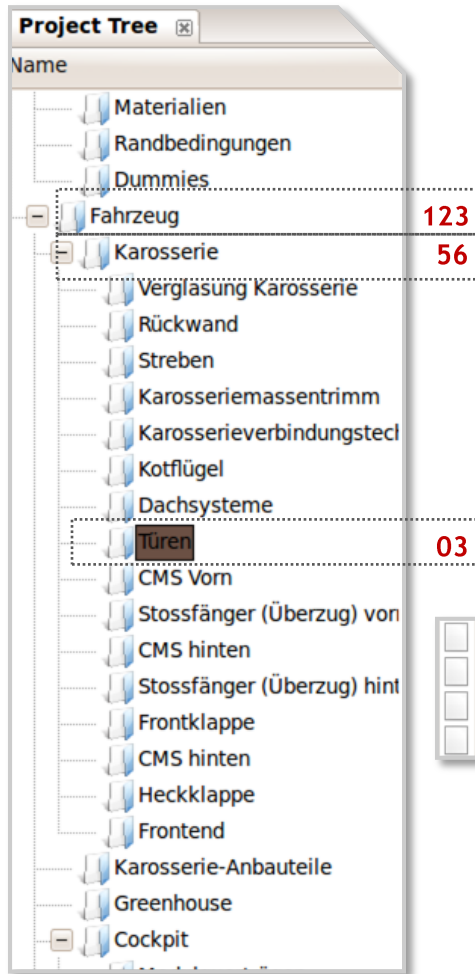


## Results View / Assessment / IT-Integration

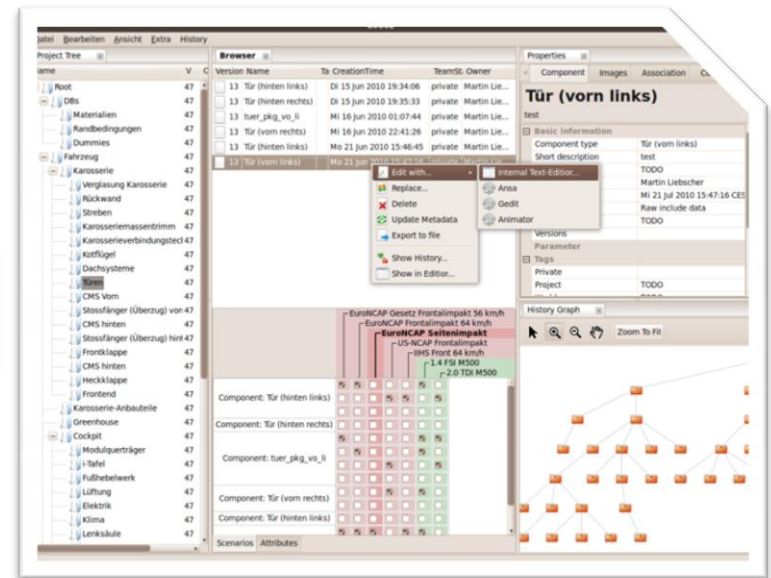
Tools, Optimization support  
CAE-Bench, Status monitoring

# Model Management and Documentation

## Logically configurable structure

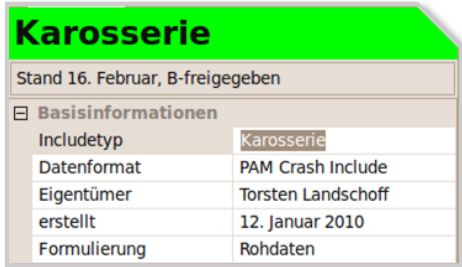


- Hierarchical structure of the complete vehicle
- Includes logically assigned into groups according to the functional aspects and disciplines
- Simplified referencing / Handling
  - Used Cockpit status 83, Door status 03 etc.
  - Door status can be treated as an include

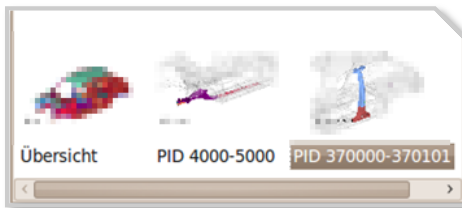


# Model Management and Documentation

## Basic Information

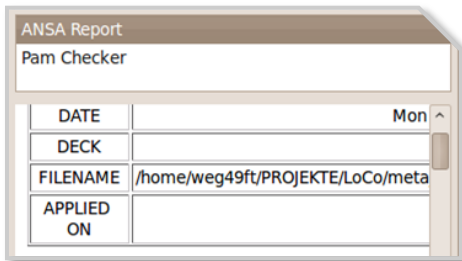


- Creator, Timestamp, ...
- Development status, Predecessor
- Sub-model type (Solver/Formulation)



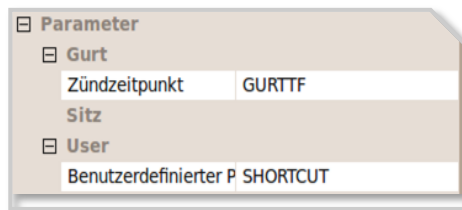
### Automatic generation of previews

- Highlighted modified geometry/parts



### Generation of reports as additions

- Addition of Documents (PPTs, DOCs, ...)
- Addition of data source e.g. ANSA Data



### Model parameterization

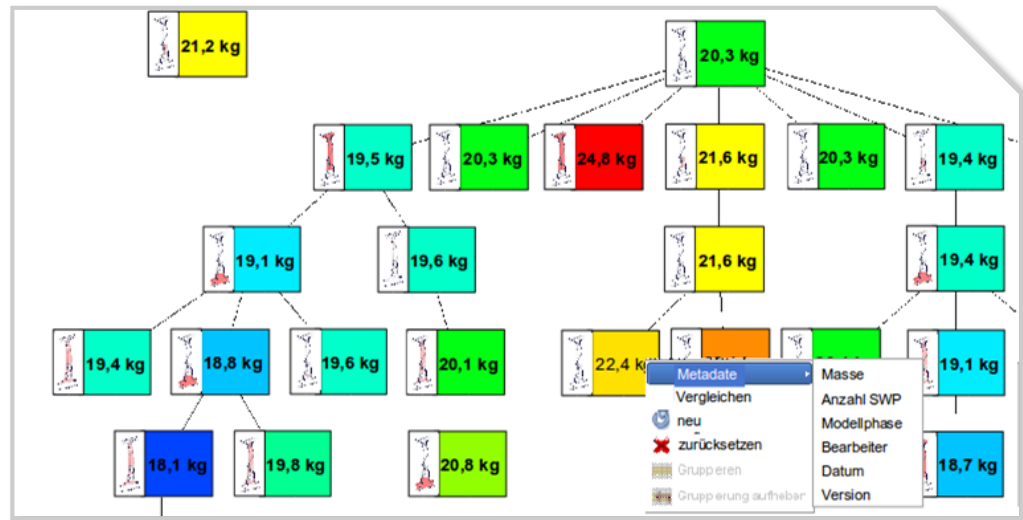
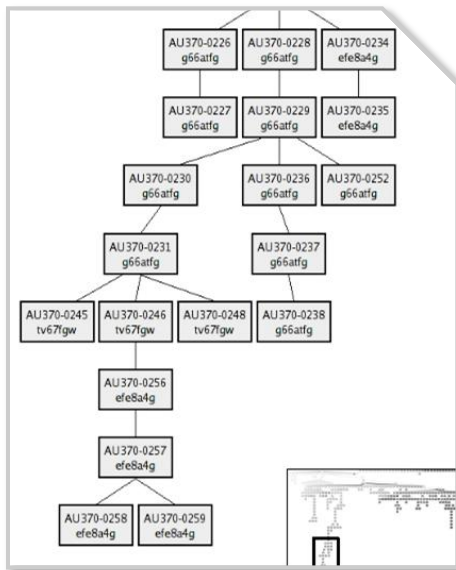
- based on placeholders and/or in solver specific format
- Pre-definition of mandatory parameters is possible
- User defined parameters

# 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

Stand 16. Februar, B-freigegeben

| Basisinformationen |                    |
|--------------------|--------------------|
| Includetyp         | Karosserie         |
| Datenformat        | PAM Crash Include  |
| Eigentümer         | Torsten Landschoff |
| erstellt           | 12. Januar 2010    |
| Formulierung       | Rohdaten           |
| Checks             | 6/21 nicht erfüllt |

Parameter

- Calculation of the quality index after each update
  - Enforce checks for numbering
  - Element quality
  - Prediction of time step / time step limit
  - ...

- Sub-model evaluation



Critical

Acceptable

Ok

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

| Include                        | Checks  | Bilder | Zuordn. |
|--------------------------------|---------|--------|---------|
| <b>Elementqualitaet</b>        |         |        |         |
| SHE:Quads < Minimum            | Falsch  |        |         |
| SHE:SKEW [NASTRAN]             | Falsch  |        |         |
| SHE:Total Shell Element        | Falsch  |        |         |
| SHE:Trias < Minimum            | Falsch  |        |         |
| SOL:Hexas > Maximum            | Richtig |        |         |
| SOL:Pentas < Minimum           | Richtig |        |         |
| SOL:Total Solids Element       | Falsch  |        |         |
| SOL:WARP [PAM-CRASH]           | Richtig |        |         |
| <b>Nummerierungskonvention</b> |         |        |         |
| CONTACT                        | Richtig |        |         |
| ELEM                           | Richtig |        |         |
| ELEM. BAR                      | Richtig |        |         |
| ELEM. SHELL                    | Richtig |        |         |
| ELEM. SOLID                    | Richtig |        |         |
| ELEM. TETRA4                   | Richtig |        |         |
| FUNCTION                       | Falsch  |        |         |
| MATER                          | Richtig |        |         |
| NODE                           | Richtig |        |         |
| NODE_ELEM                      | Richtig |        |         |
| PART                           | Richtig |        |         |
| RIGID BODY                     | Richtig |        |         |



# Aspects of SDM solutions

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## 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, ...

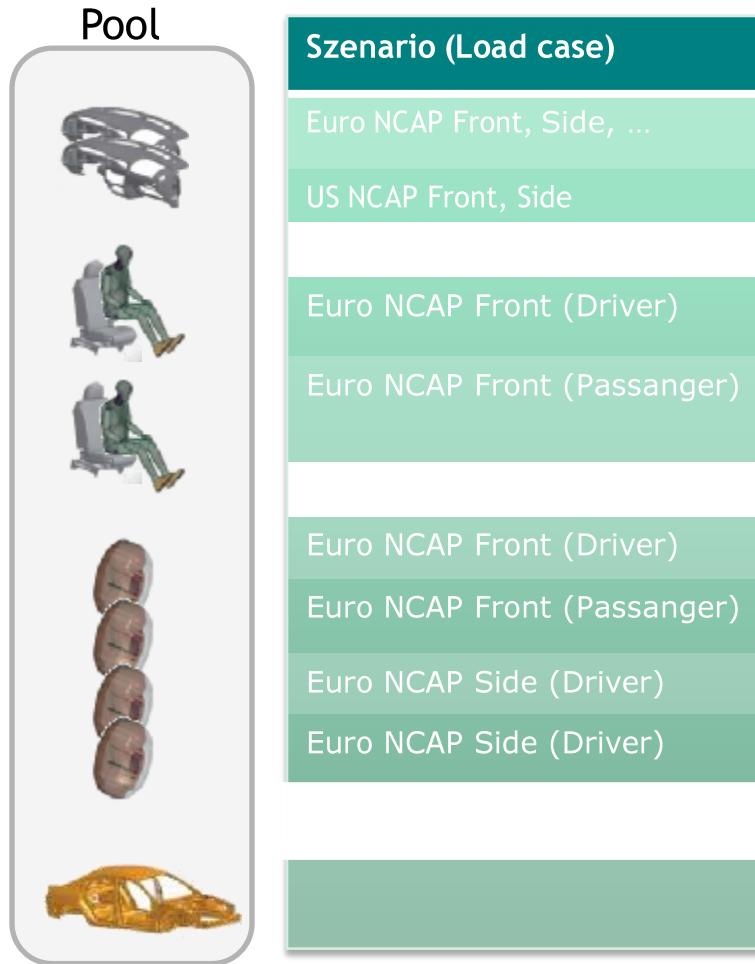


## IT-Integration

Tools, Optimization support  
CAE-Bench, Status monitoring

# Generation of complete models (Assembly)

## Sub-model assignment - Scenarios based



## 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 of complete models (Assembly)

The screenshot displays a software interface with a menu bar (Datei, Bearbeiten, Ansicht, Extra, History) and a 'Browser' window. The browser window has tabs for 'Components', 'Loadcases', and 'Runs'. On the left, a tree view shows 'Study descriptions' and 'Run descriptions' with various sub-items. The main area is a table with columns: Image, Name, ShortDescription, Scenarios, Edit status, and Attributes. The table lists several component groups and their individual parts.

| Image  | Name               | ShortDescription      | Scenarios                | Edit status | Attributes |
|--|--------------------|-----------------------|--------------------------|-------------|------------|
| - Barrieren (2 components)                         |                    |                       |                          |             |            |
|  | Barriere           | Wand Master           | <input type="checkbox"/> |             |            |
|  | Barriere           | Wand                  | <input type="checkbox"/> |             |            |
| - Bauteilverbindungen Rohkarosserie (0 components) |                    |                       |                          |             |            |
| - Cockpit (2 components)                           |                    |                       |                          |             |            |
|  | Heiz-              | klimageraet           | <input type="checkbox"/> |             |            |
|  | Modulquerträger    | modulquertr II        | <input type="checkbox"/> |             |            |
| - Dachsysteme (0 components)                       |                    |                       |                          |             |            |
| - Dummies (2 components)                           |                    |                       |                          |             |            |
|  | Dummy vorne links  | H3 50perc male        | <input type="checkbox"/> |             |            |
|  | Dummy vorne rechts | H3 50perc male        | <input type="checkbox"/> |             |            |
| - Fahrbahn (2 components)                          |                    |                       |                          |             |            |
|  | Fahrbahn           | Boden FZG FC SC HC    | <input type="checkbox"/> |             |            |
|  | Fahrbahn           | Pos Frontcrash 16Zoll | <input type="checkbox"/> |             |            |
| - Fahrwerk (8 components)                          |                    |                       |                          |             |            |
|  | Fahrwerk vorn      | Stahlraeder16         | <input type="checkbox"/> |             |            |

# Generation of complete 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

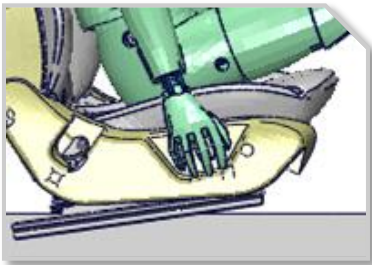
# Generation of complete models (Assembly)

## 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

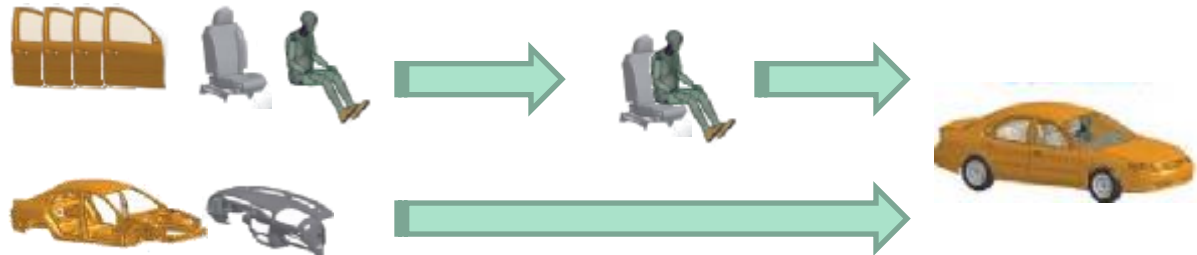
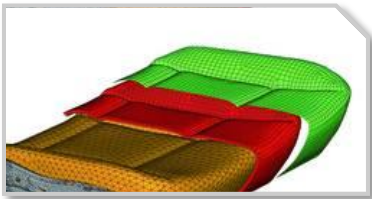


### Assembly

Selecting sub-models

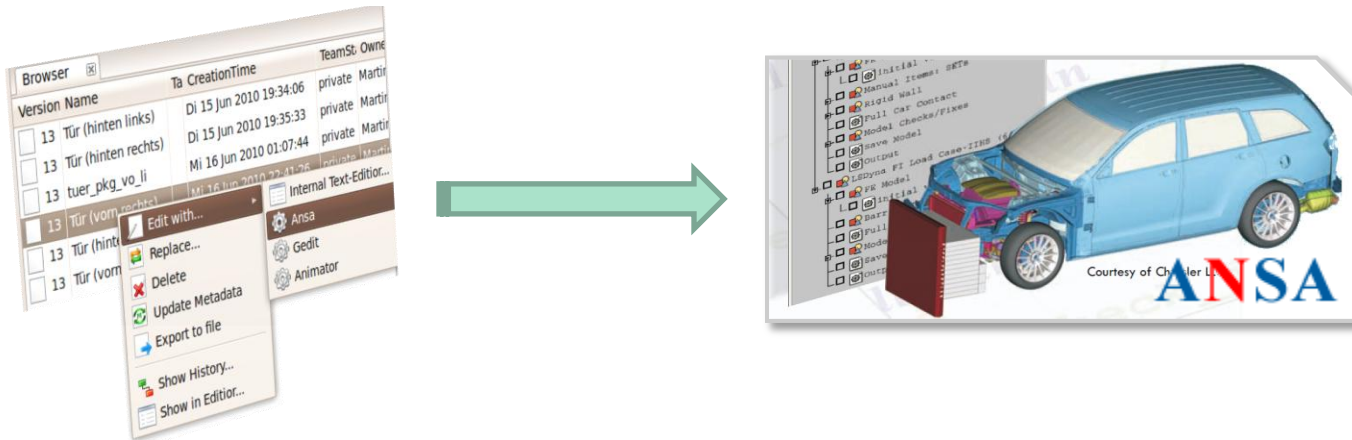
Flow calculation

Overall Model

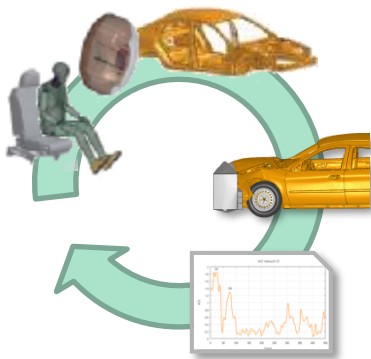


# IT-Integration - Linkage Tools

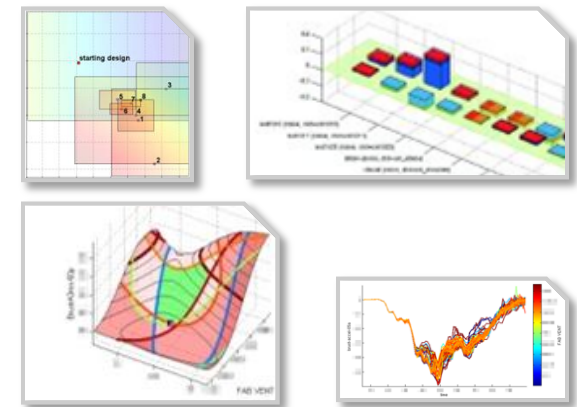
Direct calls to external tools, user scripts, link-up CAE-Bench



Integration optimization support

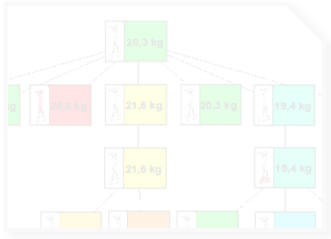


- Models are parameterized
- Simulation models are assembled automatically
- Linkage to Optimization software like LS-OPT



# Aspects of SDM solutions

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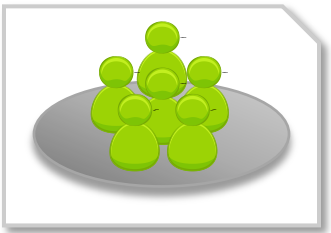
## Model management and -documentation

Includes data, Sub-models...  
Metadata, History



## Generation of complete model / Assembly

Assignment, Scenarios, Attributes etc.  
Assembler, Templates



## Team work

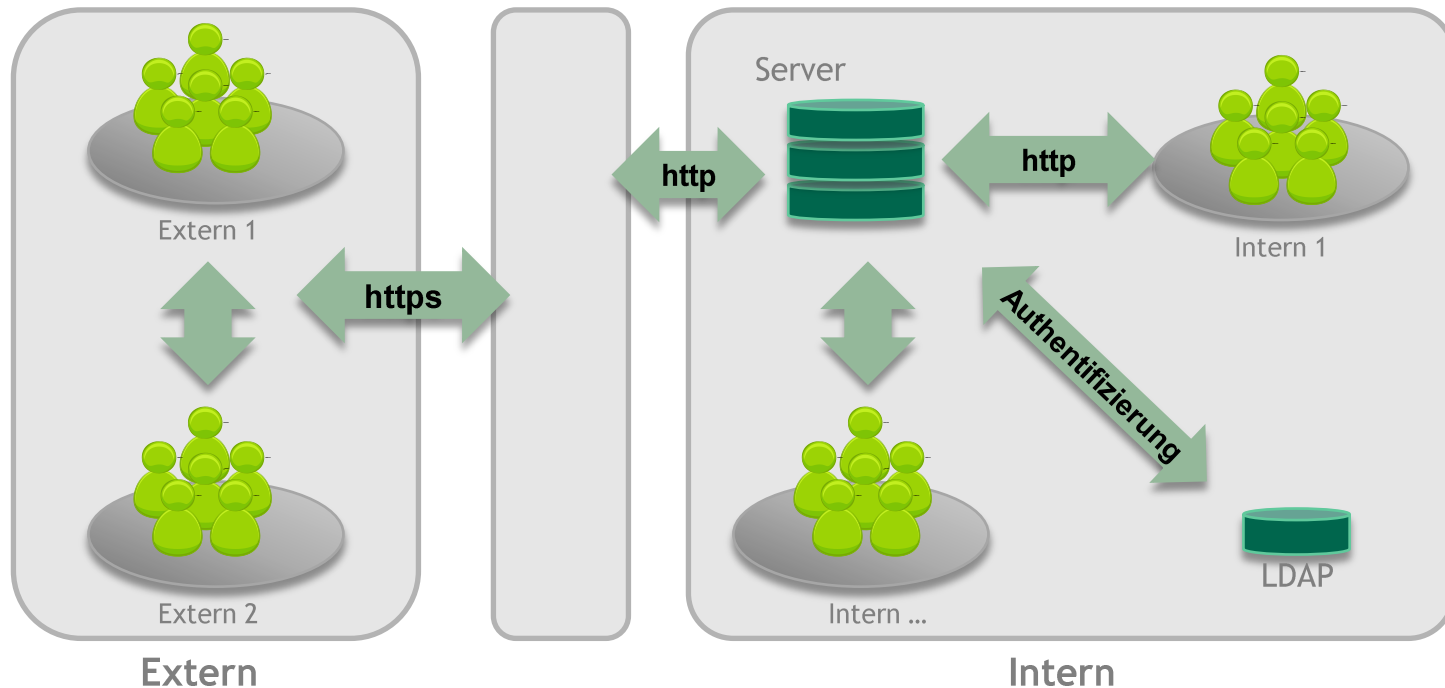
Data sharing, Local cache, Offline/Online working  
Flags, Status, ...



## IT-Integration

Tools, Optimization support  
CAE-Bench, Status monitoring

# Teamwork - Synchronisation Intern, Extern, Teams...



Sync  
Centralized/  
Decentralized

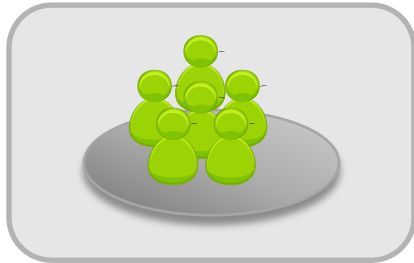
Offline/Online  
Working

- Centralized data handling and synchronization with central server (potential bottleneck); **Server data status is the reference data set**
- Decentralized synchronization is also possible between the teams and within the teams
- Offline processing of the data (Rich Client) - person/teams are independent from server; avoids bottleneck and increases performance through local caches of data
- Internal/external transfer of data over web services (standard protocols http/https)



# Teamwork - More Features

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## Rights management

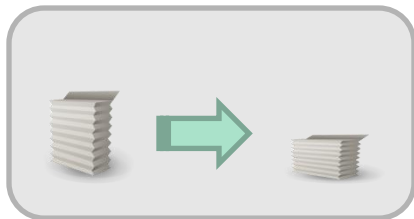
- Enabling (read/write) of sub-models / projects / sections for user, user groups
- Private/public status of one's own data



## Tags

- Highlight data / assignment of properties

Examples: milestone; obsolete, ...



## 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

# Fini

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