

# New Concepts in CAE Data and Process Management in Car Development

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Simulation Process and Data Management (SDM)

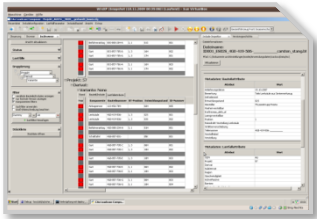
# Contents

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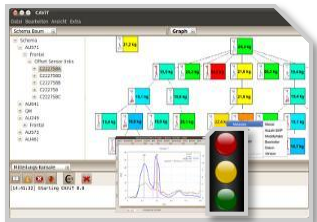
## Introduction

Classification  
Motivation



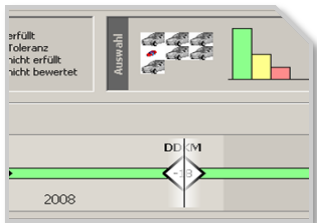
## Case Study 1

CAE data and variant management, administration of data, collaborative work, integrated documentation



## Case Study 2

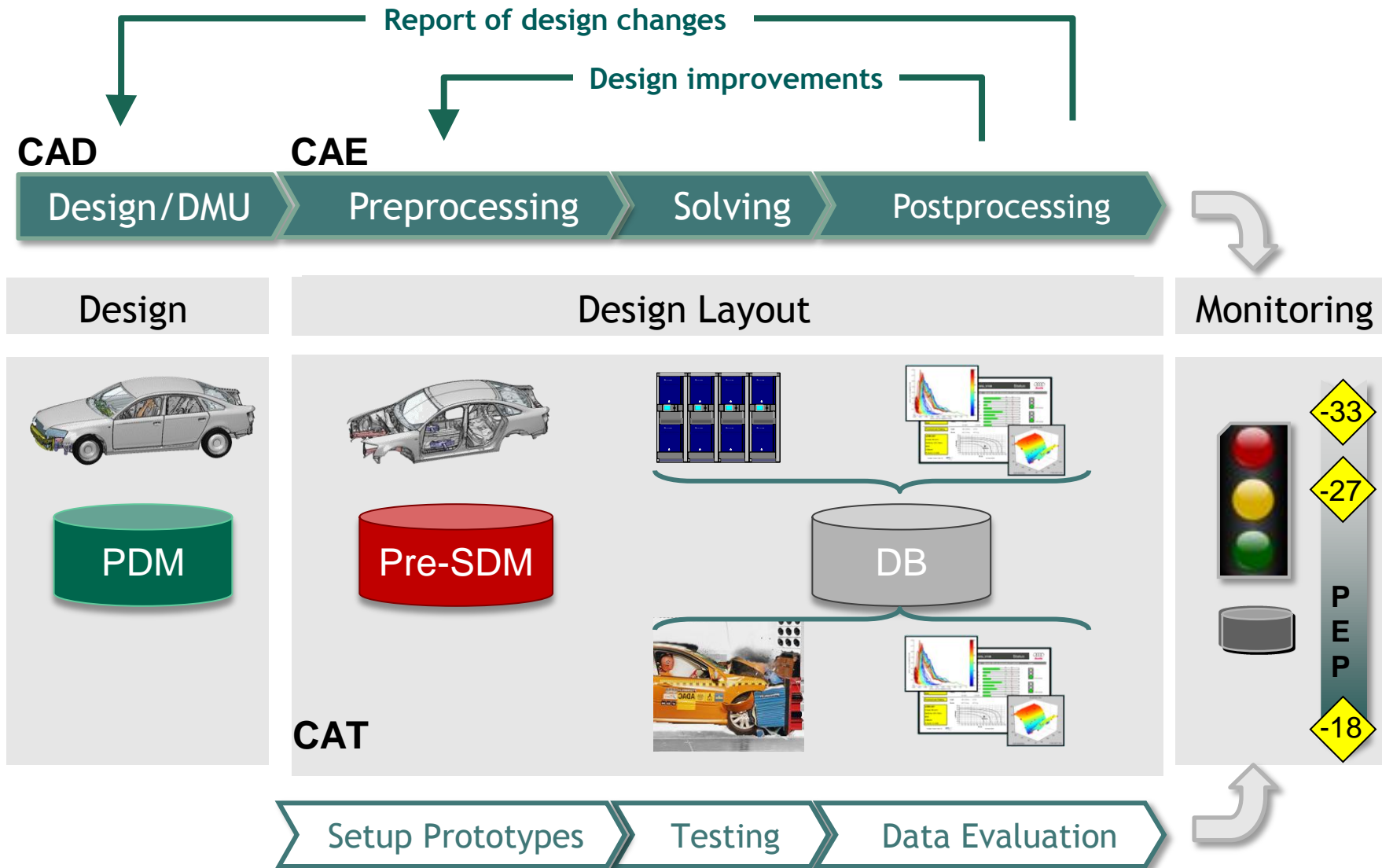
Automation of result extraction,  
reporting, comparison simulation/testing



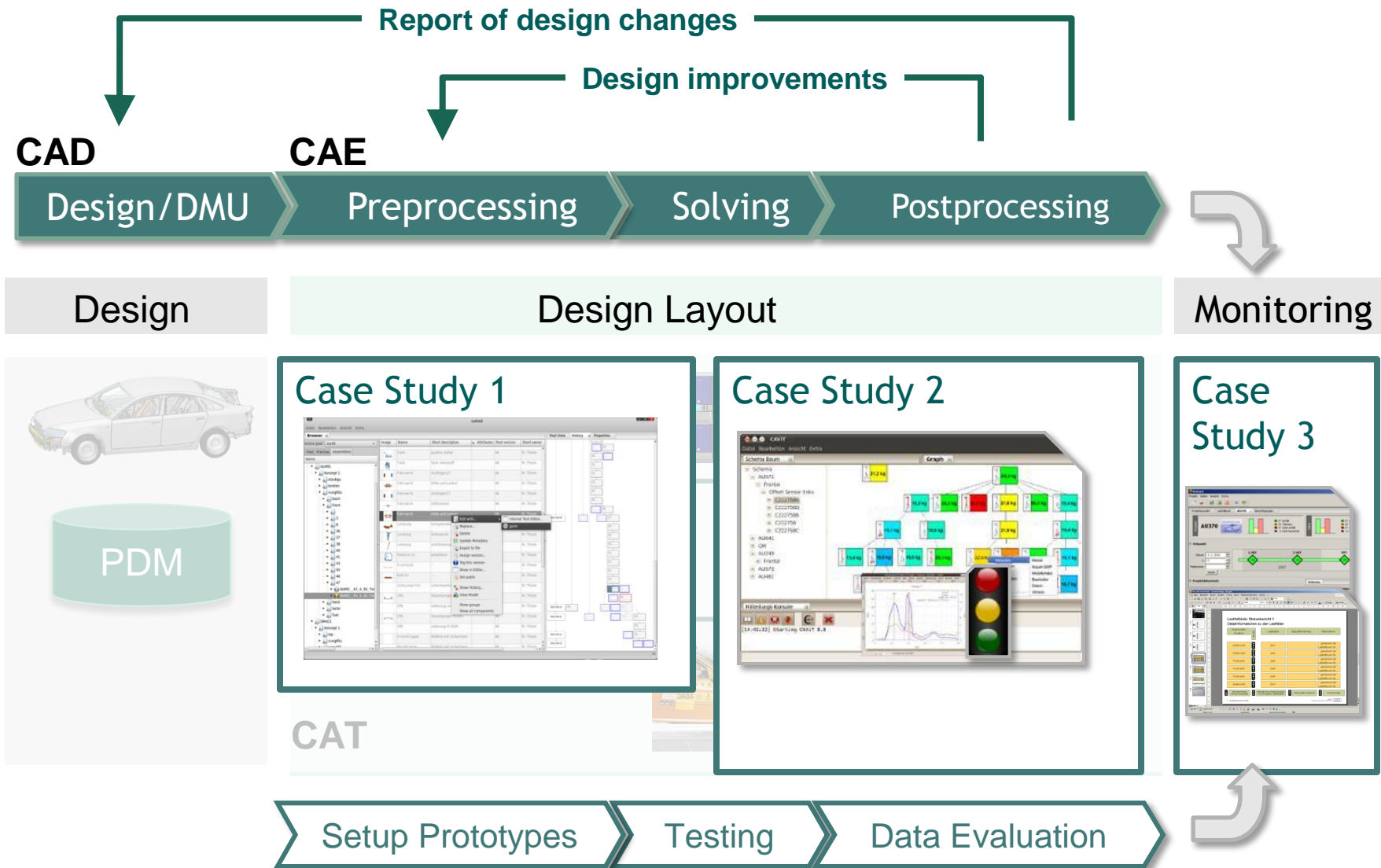
## Case Study 3

Monitoring of development status

# Introduction - Classification



# Introduction - Case Studies



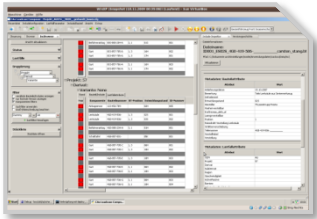
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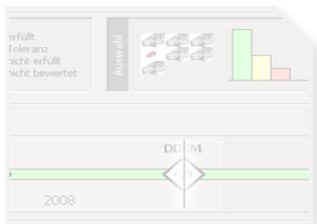
## Case Study 1

CAE data- and variant management, administration of data, collaborative work, integrated documentation



## Case Study 2

Automation of result extraction,  
reporting, comparison simulation/testing



## Case Study 3

Monitoring of development status

# Case Study 1: *SDM-Solution*

## Software System for Management of Simulation Input Data

### ■ Target Group

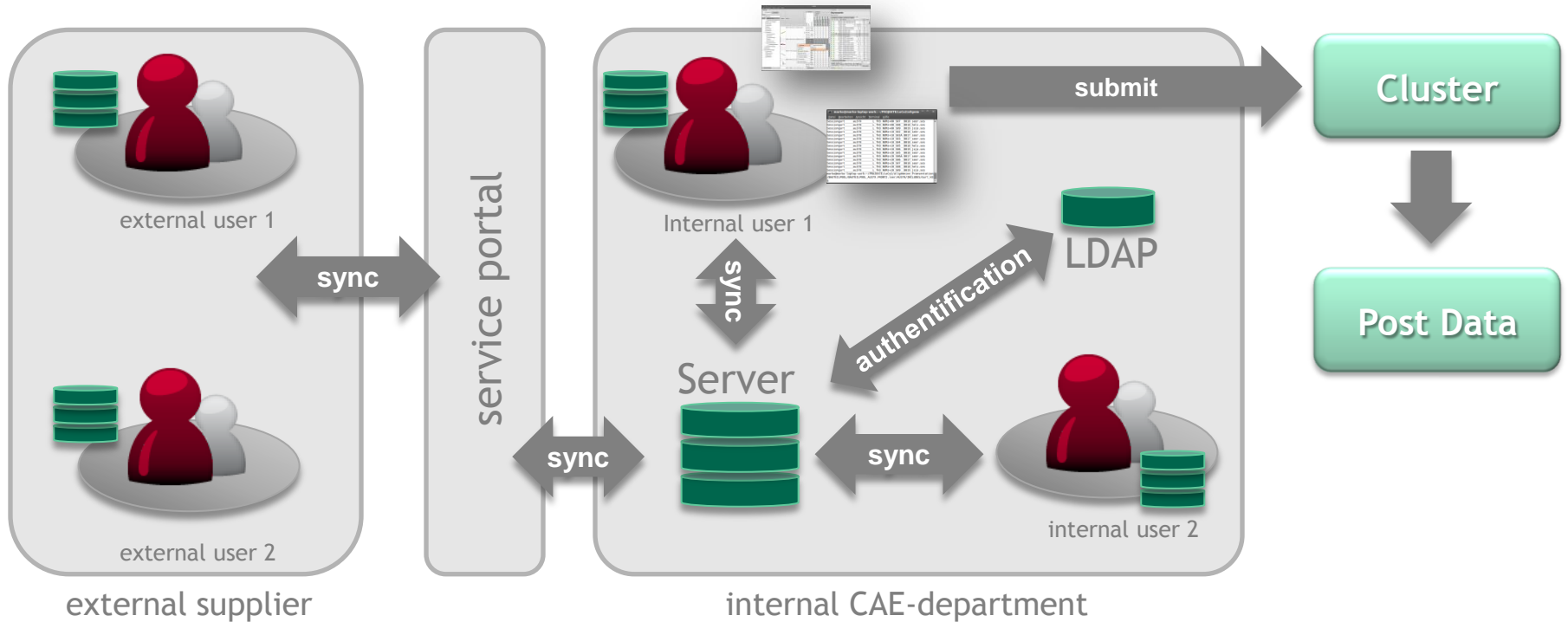
- CAE-engineers
- Leader of simulation projects



### ■ Motivation

- Synergy *Sharing of common parts*
- Transparency *Integrated documentation*
- Consistency *Synchronisation within all project members*
- Time Savings *Automation of processes*
- Homogeneity *Unification of the simulation data and enforce standards*

# Case Study 1: Workflow, Teamwork and Synchronization



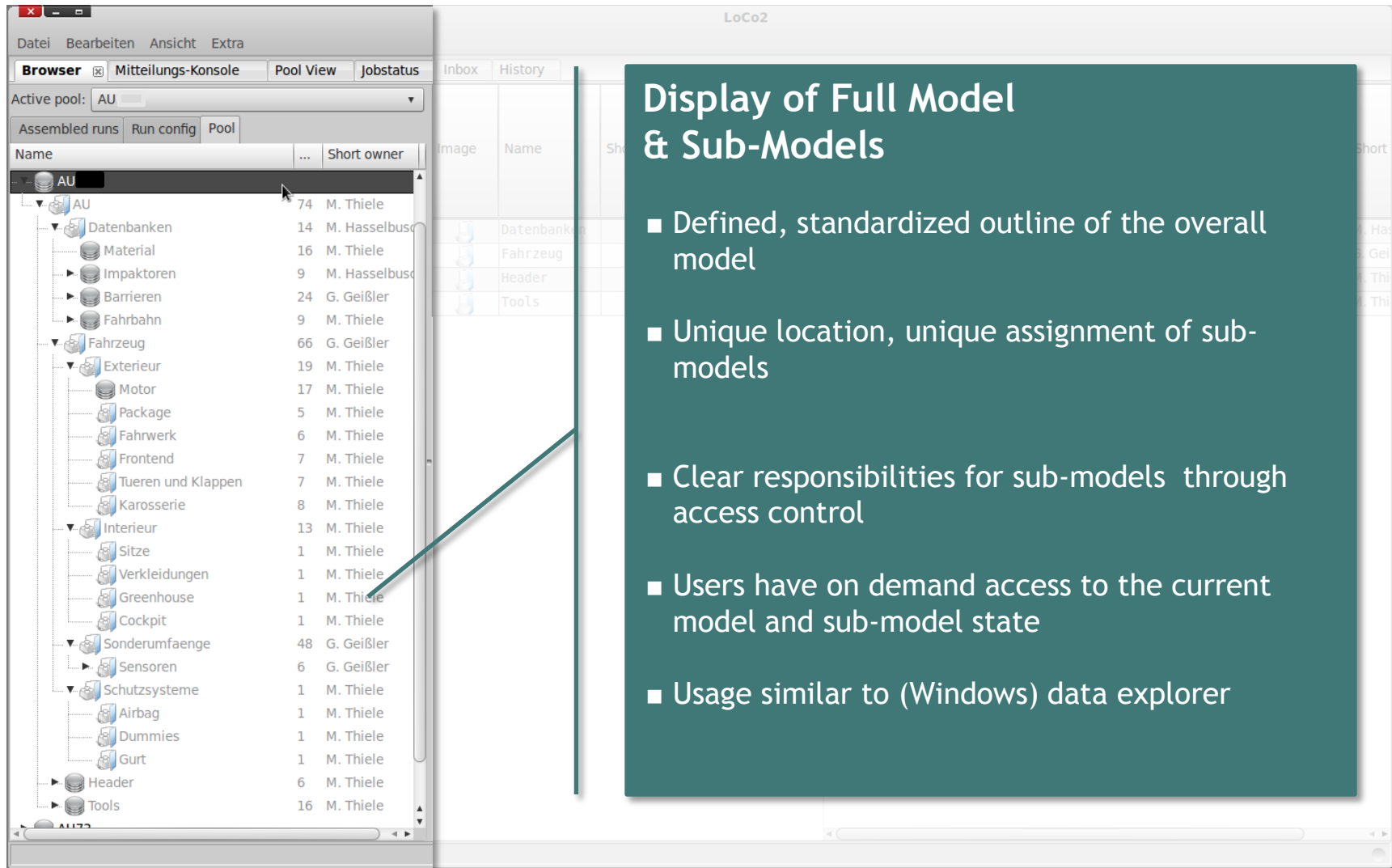
Sync  
decentralized

- Central data storage, but synchronization with local cache
- Synchronisation even within teams or users

Offline / Online  
performance

- Offline handling of components (RichClient)
  - Users/Teams are independent of servers and infrastructure
  - Users work with local data
  - Good performance while application of preprocessing tools
- Data transfer by means of web services

# Case Study 1: *Features*



The screenshot shows a software interface with a menu bar (Datei, Bearbeiten, Ansicht, Extra) and a toolbar (Browser, Mitteilungs-Konsole, Pool View, Jobstatus). The active pool is 'AU'. Below the toolbar is a table with columns 'Name' and 'Short owner'. The table lists sub-models and their owners:

Name	Short owner
AU	74 M. Thiele
Datenbanken	14 M. Hasselbusch
Material	16 M. Thiele
Impaktoren	9 M. Hasselbusch
Barrieren	24 G. Geißler
Fahrbahn	9 M. Thiele
Fahrzeug	66 G. Geißler
Exterieur	19 M. Thiele
Motor	17 M. Thiele
Package	5 M. Thiele
Fahrwerk	6 M. Thiele
Frontend	7 M. Thiele
Tueren und Klappen	7 M. Thiele
Karosserie	8 M. Thiele
Interieur	13 M. Thiele
Sitze	1 M. Thiele
Verkleidungen	1 M. Thiele
Greenhouse	1 M. Thiele
Cockpit	1 M. Thiele
Sonderumfaenge	48 G. Geißler
Sensoren	6 G. Geißler
Schutzsysteme	1 M. Thiele
Airbag	1 M. Thiele
Dummies	1 M. Thiele
Gurt	1 M. Thiele
Header	6 M. Thiele
Tools	16 M. Thiele

The dark green box on the right contains the following text:

## Display of Full Model & Sub-Models

- Defined, standardized outline of the overall model
- Unique location, unique assignment of sub-models
- Clear responsibilities for sub-models through access control
- Users have on demand access to the current model and sub-model state
- Usage similar to (Windows) data explorer



# Case Study 1: *Features*

The screenshot displays the LoCo2 software interface. On the left is a tree view showing a hierarchical structure of components under 'AU49'. The main area features a table with the following data:

Image	Name	Short description	Attributes	Pool version	Short owner
	Tank	quattro Sattel		46	M. Thiele
	Tank	Tank Harnstoff		46	M. Thiele
	Fahrwerk	Alufelgen17		46	M. Thiele
	Fahrwerk	HiRa und Lenker		46	M. Thiele
	Fahrwerk	Alufelgen17		46	M. Thiele
	Fahrwerk	Differential		46	M. Thiele
	Fahrwerk	HiRa und Lenker		46	M. Thiele
	Lenkung	lenkgetriebe			
	Lenkung	lenksaeule			M. Thiele
	Lenkung	lenkteleskop			M. Thiele
	Pedalerie	pedalbock			M. Thiele
	Frontend	--			M. Thiele
	Kuehler	--			M. Thiele
	Scheinwerfer	scheinwerfer			M. Thiele
	CMS	Stossfaenge			M. Thiele
	CMS	ueberzug vo			M. Thiele
	CMS	Stossfaenger hinten		46	M. Thiele
	CMS	ueberzug hi NSM		46	M. Thiele
	Frontklappe	NSMAS inkl Scharniere		46	M. Thiele
	Heckklappe	NSMAS inkl Scharniere		46	M. Thiele

A context menu is open over the 'HiRa und Lenker' row, listing actions such as 'Edit with...', 'Replace...', 'Delete', 'Update Metadata', 'Export to file', 'Assign version...', 'Tag this version', 'Show in Editor...', 'Set public', 'Show History...', and 'View Model'. The 'View Model' option is highlighted. A 'gvim' window is also visible in the background.

On the right, a 'Pool View' window shows a tree diagram of components. A callout box titled 'Clarity' points to the table and tree view, listing:

- Listing of all include files (sub-models)
- Thumbnails for quick overview

Another callout box titled 'Intuitive context-sensitive actions' points to the context menu.

# Case Study 1: Features

The screenshot displays the LoCo2 software interface. On the left, a tree view shows the project structure for 'AU491', including 'Konzept 1' and 'Front'. The main table lists parts with columns for Image, Name, Short description, Attributes, Pool version, and Short owner. A dark green callout box titled 'History' is overlaid on the table, listing features: visualization of generation order, tracking of target values, comments, thumbnails with visualization of changed parts, and different zoom levels. On the right, a 'History' window shows a sequence of changes to a door lock assembly, numbered 1 through 15, with thumbnails and comments for each step.

Image	Name	Short description	Attributes	Pool version	Short owner
	Frontend	--		46	M. Thiele
	Kühler	--		46	M. Thiele
	Scheinwerfer	scheinwerfer vo NSM		46	M. Thiele
	CMS	Stossfaenger vorne		46	M. Thiele
	CMS	ueberzug vo NSM		46	M. Thiele
	CMS	Stossfaenger hinten		46	M. Thiele
	Tuer	Tuerscheibe oben		46	M. Thiele
	Tuer	Rohbau inkl Schloss		46	M. Thiele
	Tuer	Tuerscheibe oben		46	M. Thiele
	Frontscheibe	--		46	M. Thiele
	Karosserie	EU Verst Saeule B		46	M. Thiele
	Karosserie	Heckscheibe		46	M. Thiele

### History

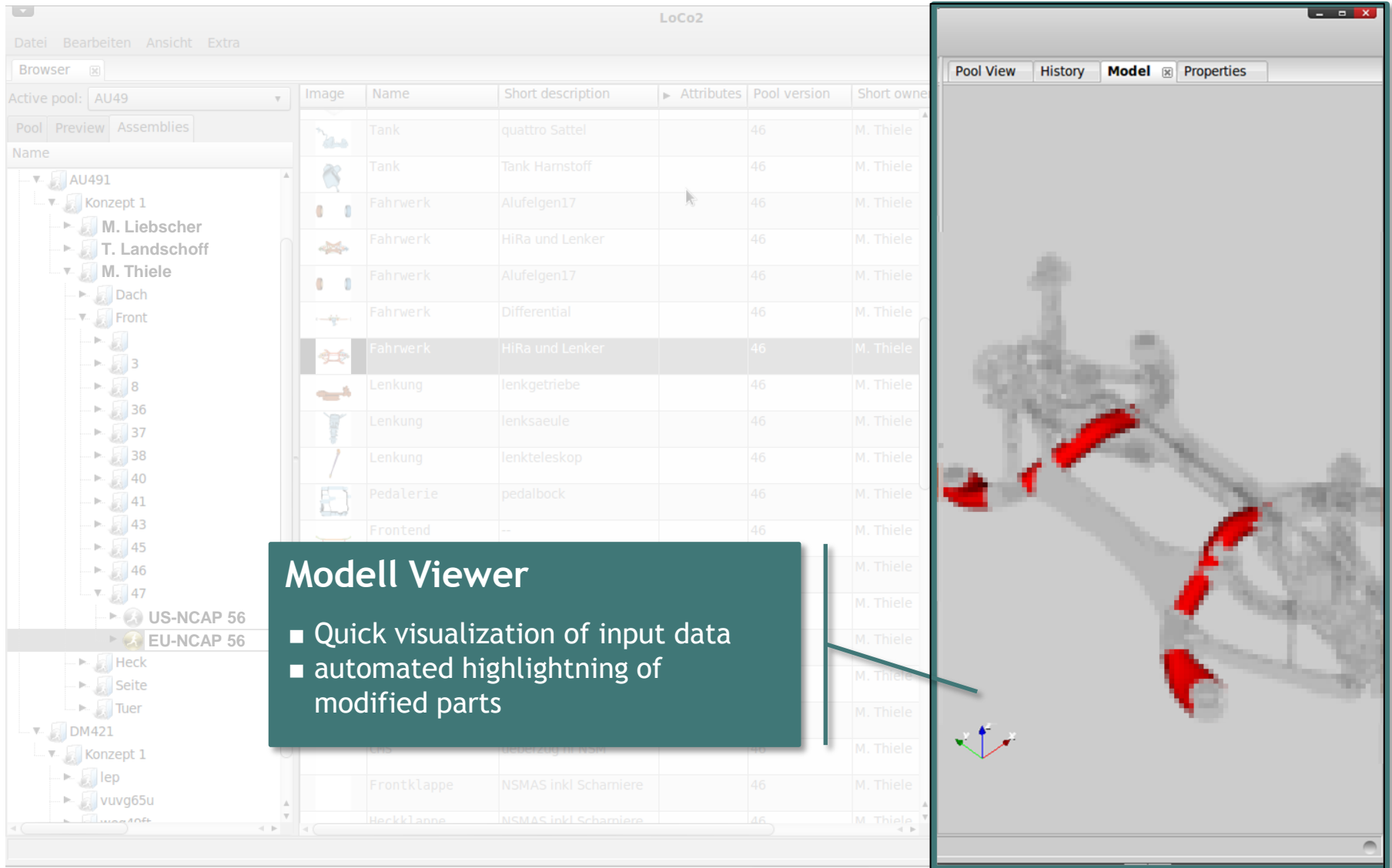
- Visualization of generation order
- Tracking of target values
- Comments
- Thumbnails with visualization of changed parts
- Different zoom levels

**History View Details:**

- 1** (03.2011 15:59): Initialer Import
- 8** (28.03.2011 08:57): Eine andere Änderung am Türschloss
- 11** (03.2011 09:10): Am Rahmen kann man Masse...
- 9** (28.03.2011 09:01): Und schon wieder am Türschloss...
- 15** (03.2011 09:21): Aber auch die Masse
- 10** (28.03.2011 09:05): Und noch ein Test



# Case Study 1: *Features*



The screenshot displays the LoCo2 software interface. On the left, a tree view shows the project structure for 'AU491', including sub-projects like 'Konzept 1' and 'M. Thiele'. The main area is a table listing parts with columns for 'Image', 'Name', 'Short description', 'Attributes', 'Pool version', and 'Short owner'. The 'Fahrwerk' (chassis) row is highlighted. On the right, a 'Modell Viewer' window shows a 3D model of a bicycle chassis with several components highlighted in red. A callout box points to the viewer with the following text:

**Modell Viewer**

- Quick visualization of input data
- automated highlighting of modified parts

# Case Study 1: *Features*

LoCo2

File Edit View Extra

Browser

Active pool: AU49

Image	Name	Short description	Attributes	Pool version	Short owner
	Frontend	--		46	M. Thiele
	Kühler	--		46	M. Thiele
	Scheinwerfer	scheinwerfer vo NSM		46	M. Thiele
	CMS	Stossfaenger vorne		46	M. Thiele
	CMS	ueberzug vo NSM		46	M. Thiele
	CMS	Stossfaenger hinten		46	M. Thiele
	Tuer	Rohbau inkl Schloss		46	M. Thiele
	Tuer	Tuerscheibe oben		46	M. Thiele
	Tuer	Rohbau inkl Schloss		46	M. Thiele
	Tuer	Tuerscheibe oben		46	M. Thiele
	Frontscheibe	--		46	M. Thiele
	Karosserie	EU Verst Saeule B		46	M. Thiele
	Karosserie	Heckscheibe		46	M. Thiele

## Quality Management

- Check at each import
- User defined checks configurable
- Sanctionable on the basis of a quality index

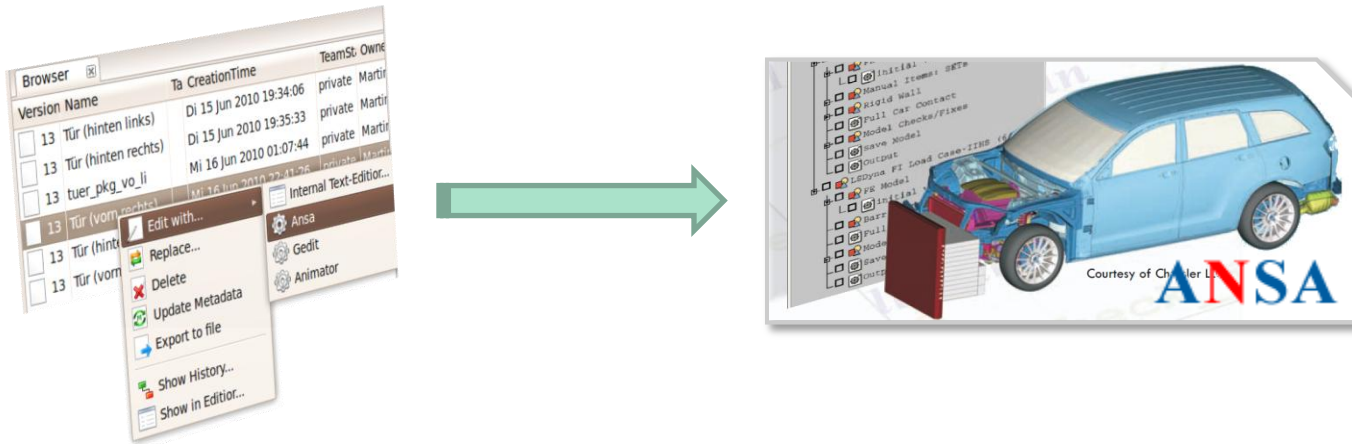
### Include-Checks: Ergebnisse

- ✗ Elementqualitaet
  - ✗ SHE:Quads < Minimum ANGLE [PAM-CRASH]
  - ✗ SHE:SKEW [NASTRAN]
  - ✗ SHE:Total Shell Elements OFF
    - zu viele schlechte Elemente: 16.342
  - ✓ SHE:Trias < Minimum ANGLE [PAM-CRASH]
  - ✓ SOL:Hexas > Maximum ANGLE [PAM-CRASH]
  - ✓ SOL:Pentas < Minimum ANGLE [PAM-CRASH]
  - ✗ SOL:Total Solids Elements OFF
    - zu viele schlechte Elemente: 100.000
  - ✓ SOL:WARP [PAM-CRASH]
- ✓ Nummerierungskonvention
  - ✓ CONTACT
  - ✓ ELEM
  - ✓ ELEM. BAR
  - ✓ ELEM. SHELL
  - ✓ ELEM. SOLID
  - ✓ ELEM. TETR4
  - ✓ FUNCTION
  - ✓ MATER
  - ✓ NODE
  - ✓ NODE\_ELEM
  - ✓ PART
  - ✓ RIGID BODY
  - ✓ TIED
- ⚠ Gruppen - Definiert/Referenziert

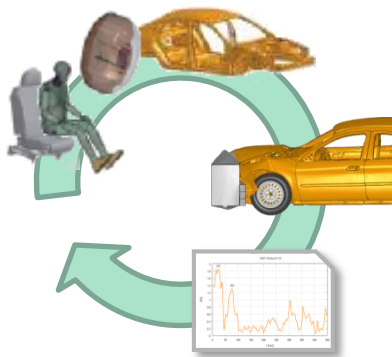


# Case Study 1: Open System / Integration of Software

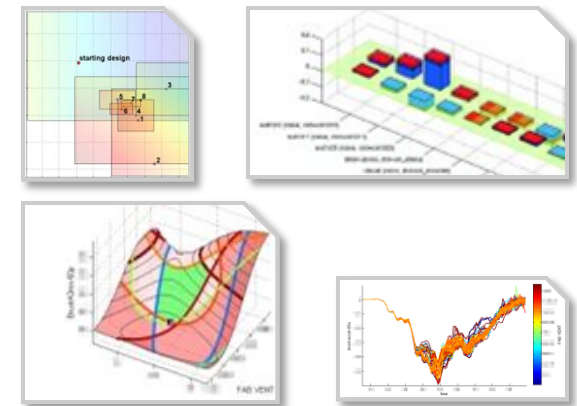
Direct application of external tools (*Ansa, Animator, nedit, vi, Userskrips, etc...*)



## Integration of DOE Studies / Optimization



- Models are parameterized within the data management system
- Simulation models are assembled automatically
- Access to optimization software such as LS-OPT



# Summary - Case Study 1



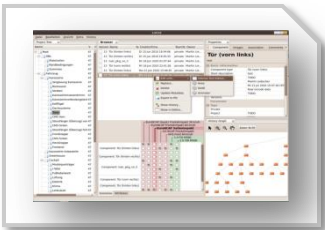
## Customizable Rich Client

- Adaptation to customer requirements
- Structuring / standardizing of work flow
- Continuous documentation of components and sub-models



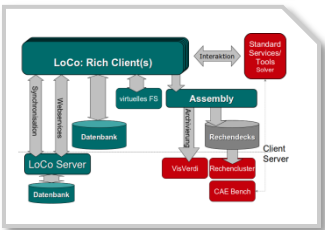
## Modul Strategy for Simulation

- Simple cross-disciplinary reusability of components
- Rights and role management for exchange with suppliers or other teams



## Intuitive Usage

- Report of simulation model status on demand
- Interface focus on established work processes
- Tailored to the needs of simulation engineers



## Very Good Performance

- Largely independent of the performance of the network infrastructure
- Synchronization automatically in the background
- Use of efficient mechanisms for data reduction



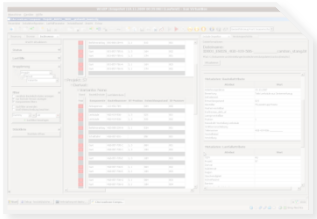
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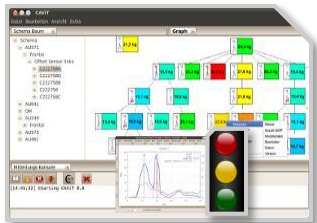
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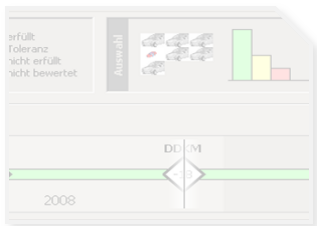
## Case Study 1

CAE data- and variant management, administration of data, collaborative work, integrated documentation



## Case Study 2

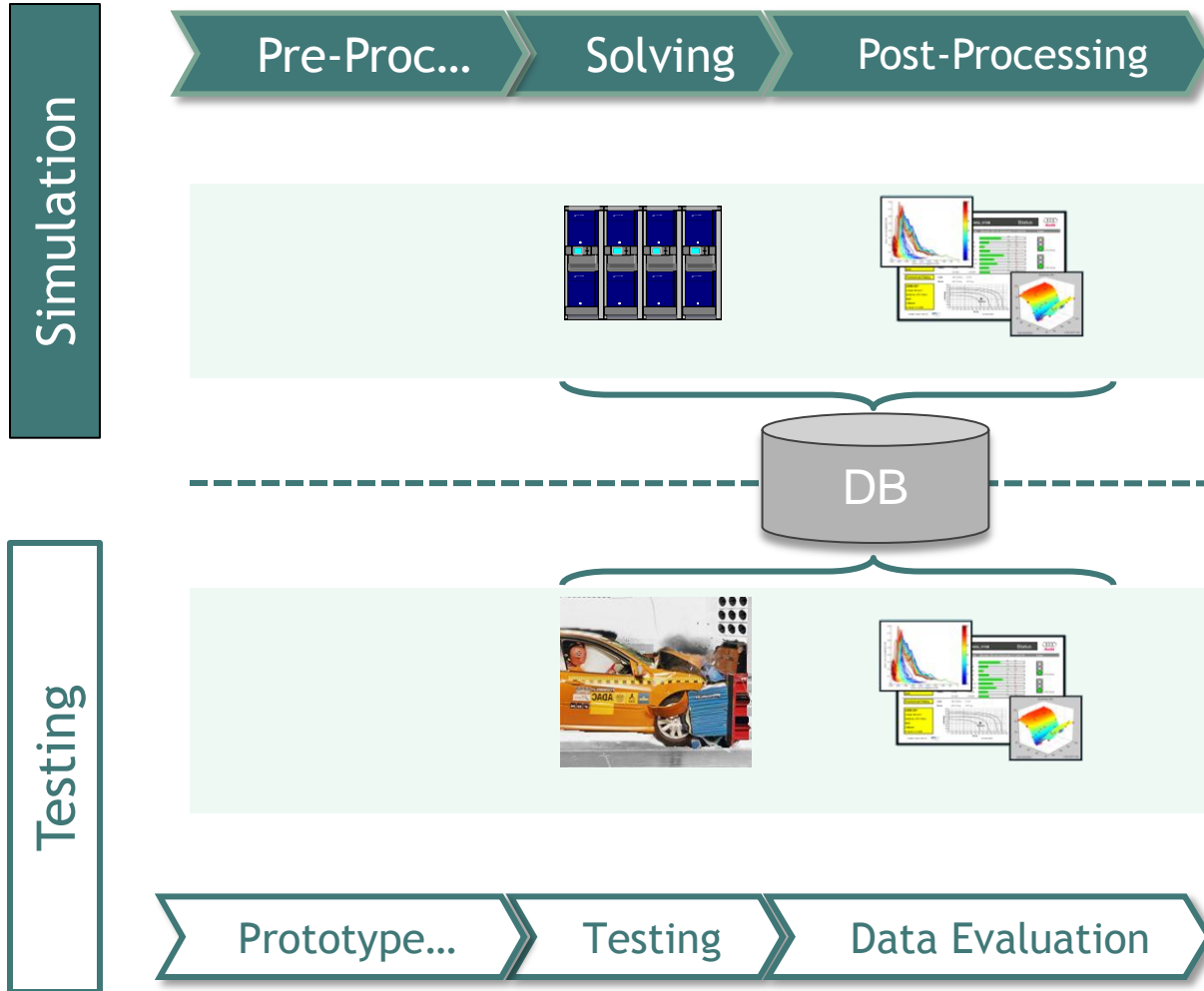
Automation of result extraction,  
reporting, comparison simulation/testing



## Case Study 3

Monitoring of development status

# Case Study 2: Analysis and Evaluation of CAx Data



# Case Study 2: *Analysis and Evaluation of CAx Data*

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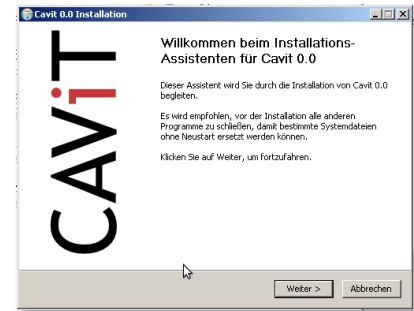
## Software System for Data Collection and Evaluation of Test- and Simulation Data

### ■ Target Group

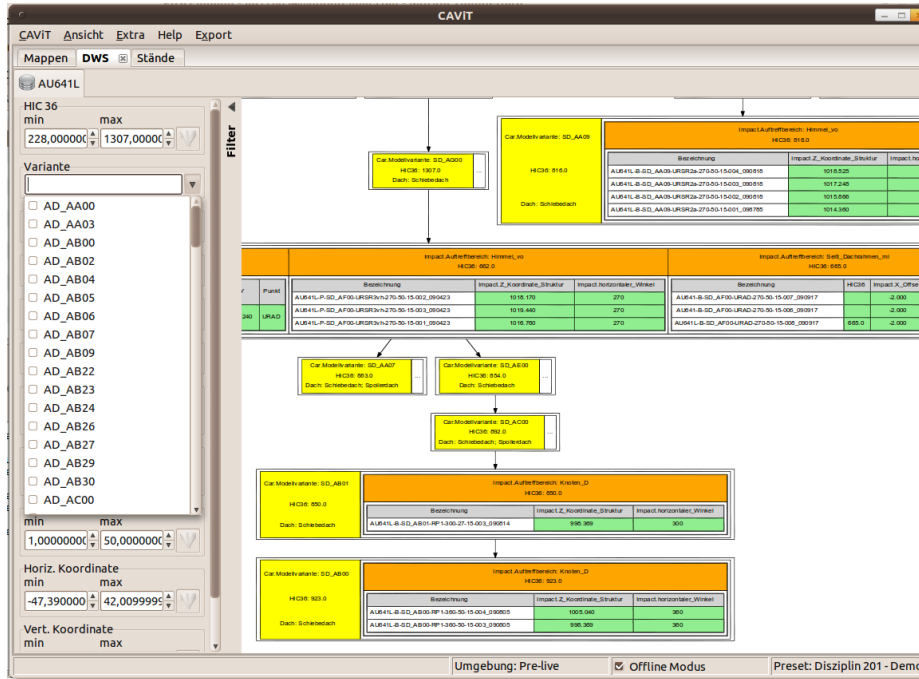
- Test and simulation engineers
- Component responsible people

### ■ Motivation

- Integration *Merging experimental and simulation data*
- Evaluation *Support for automatic creation of standardized documentation / reports*
- Assessment *Semi-automated evaluation and acquisition of key evaluations of individual experiments / simulations*
- Comparison *Identification of differences between experiment and simulation*

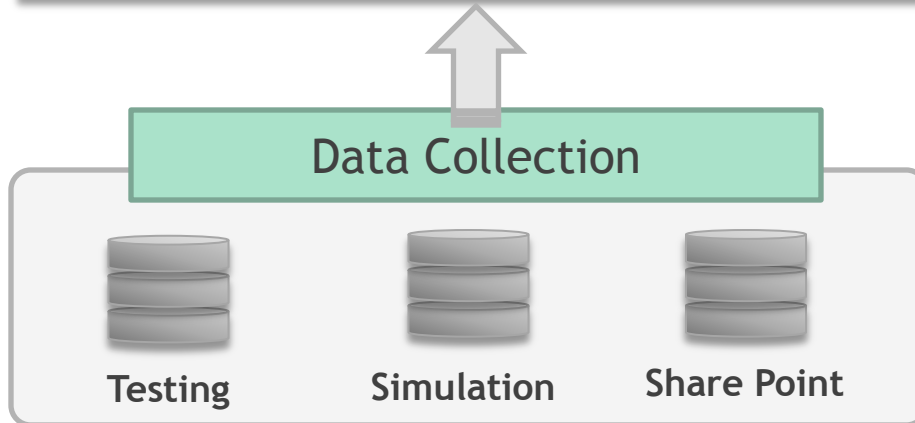


# Case Study 2: Analysis and Evaluation of CAx Data



## Characterization

- Data collection from several backend systems
- Cache of data for fast local access, particularly important for bulk data
- Uniform handling of test and simulation data
- Agglomerated view of data [configurable]  
Pedigree representation



# Case Study 2: Visualization

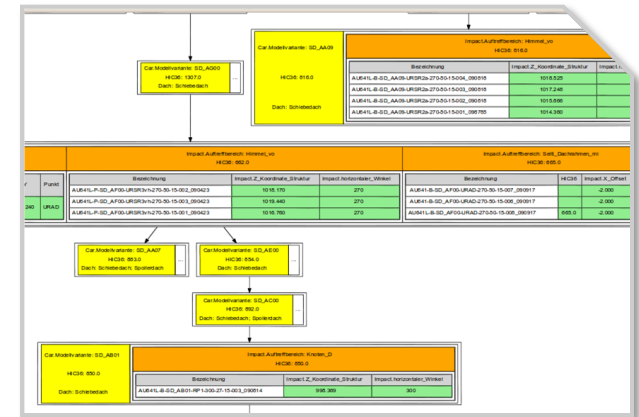
## Visualization Features

- Graph / pedigree
- Table view
- Matrix representation

## User Configurable View

- Automated color based assessment of results
- Representation of team project status

## Graph



## Table

	HIC 36	Impact	Auftreffbereich	Punkt	Punkt
AU641L-P-PD_AB02-AP2-255-50-12-005_090331	98.0	A-Saeule	AP2	AP	
AU641L-P-PD_AB02-AP2-225-50-12-005_090331	95.0	A-Saeule	AP2	AP	
AU641L-B-GD_MA01-AP1-230-35-12-002_090804	97.0	A-Saeule	AP1	AP	
<b>▼ B-Saeule</b>					
AU641L-B-GD_MA01-BP3-275-1-15-001_090724	95.0	B-Saeule	BP3	BP	
<b>▼ C-Saeule</b>					
AU641L-P-SD_AD01-RP1-345-50-15-001_080509	98.0	C-Saeule	RP1	RP	
AU641L-P-SD_AA13-RP1-345-50-15-001_080407	97.0	C-Saeule	RP1	RP	
AU641L-P-SD_AD04-RP1-330-45-15-001_080513	98.0	C-Saeule	RP1	RP	
AU641L-B-SD_AQ01-UROP1-270-42-15-004_091021	92.0	C-Saeule	UROP1	UR	
AU641L-P-SD_AA17-RP1-315-36-15-001_080410	93.0	C-Saeule	RP1	RP	
AU641L-B-SD_MA00-URD-270-42-15-004_090722	99.0	C-Saeule	URD	UR	
AU641L-P-SD_AA03-RP1-345-50-15-001_080402	98.0	C-Saeule	RP1	RP	
AU641L-P-AD_AA00-OP1-270-31-15-001_090417	99.0	C-Saeule	OP1	OP	
AU641L-P-SD_AD03-RP1-303-14-15-001_080513	97.0	C-Saeule	RP1	RP	
AU641L-P-SD_AA03-RP1-315-36-15-001_080402	93.0	C-Saeule	RP1	RP	

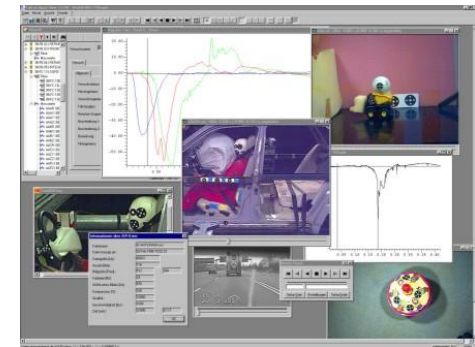
## Matrix

	max:URev	URev_15	URev_30	URev_60	URev_X1150	API_r002	API_r001	API_r004	API_r003A
SD_ZC00	818 785 778	818 813 813 806 812 812	815 801 805 803 808 808	815 805 805 803 808 808	815 805 805 803 808 808	827 824 824	824 824	824 824	824 824
SD_ZC01	822 804 798	822 750 818 802 798	822 816 822 802 798	822 816 822 802 798	822 816 822 802 798	822 822	822 822	822 822	822 822
SD_ZC02	825 810 804	825 784 825 810 804	825 816 825 810 804	825 816 825 810 804	825 816 825 810 804	825 825	825 825	825 825	825 825
SD_ZC03	820 820	820 820	820 820	820 820	820 820	820 820	820 820	820 820	820 820
SD_ZC04	820 792 784	820 746 819 792 784	820 812 820 800 800 800	820 812 820 800 800 800	820 812 820 800 800 800	820 820	820 820	820 820	820 820
SD_ZC07	806 743 732	806 724 771 743 732	806 804 794 743 732	806 804 794 743 732	806 804 794 743 732	806 806	806 806	806 806	806 806

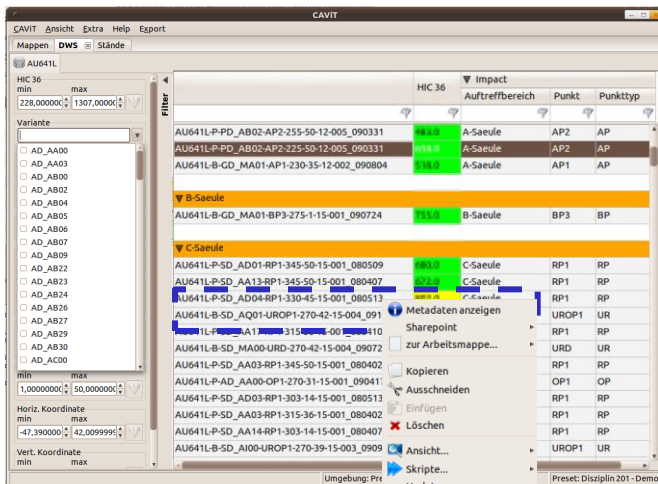
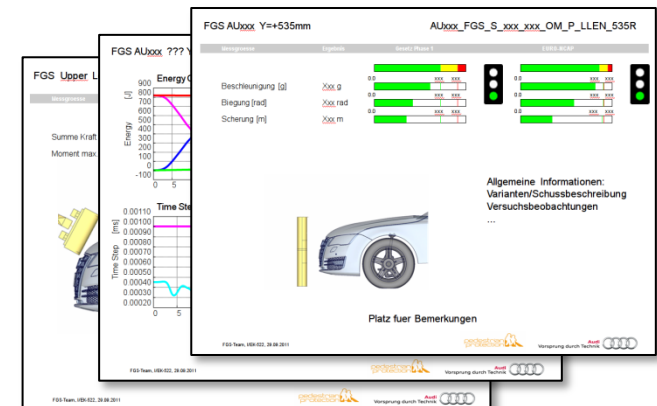
# Case Study 2: Scripting Extension - Open System

- Functionalities can be extended by user through “Scripting Extensions”
- Arbitrary script languages can be applied
- Template technology is cross platform available (Windows and Linux)
- Application
  - Automation of report generation
  - Interface to other applications

[FalCon]



[Animator]



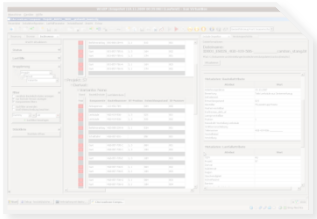
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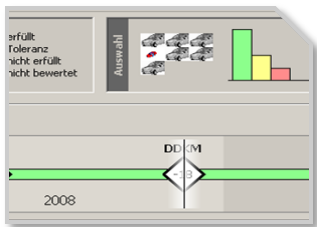
## Case Study 1

CAE data- and variant management, administration of data, collaborative work, integrated documentation



## Case Study 2

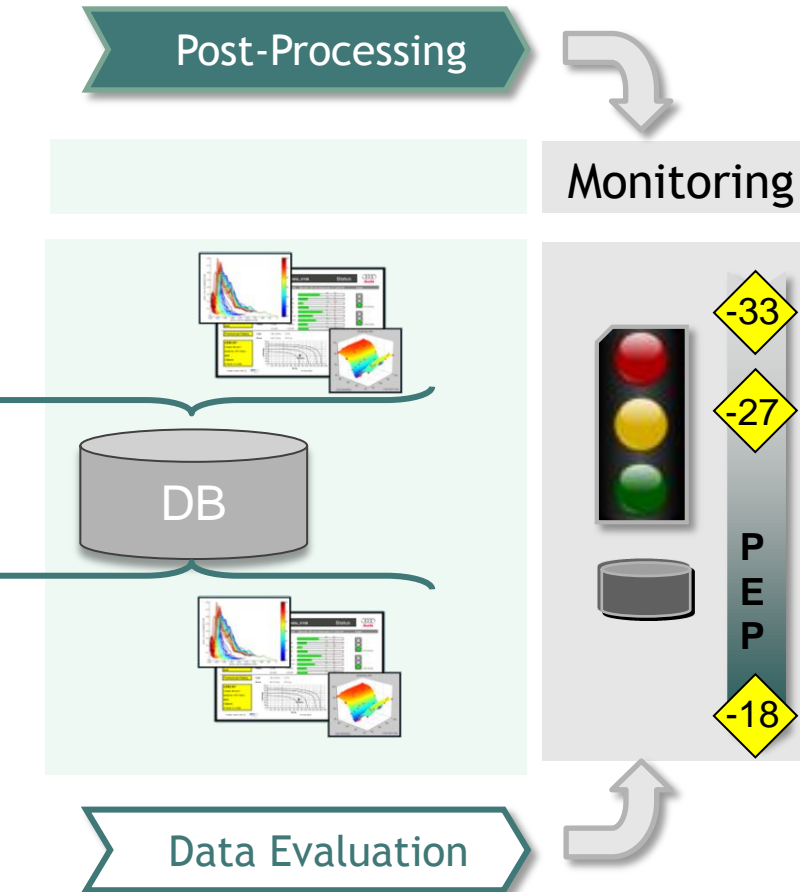
Automation of result extraction,  
reporting, comparison simulation/testing



## Case Study 3

Monitoring of development status

# Case Study 3: Project- and Status Monitoring



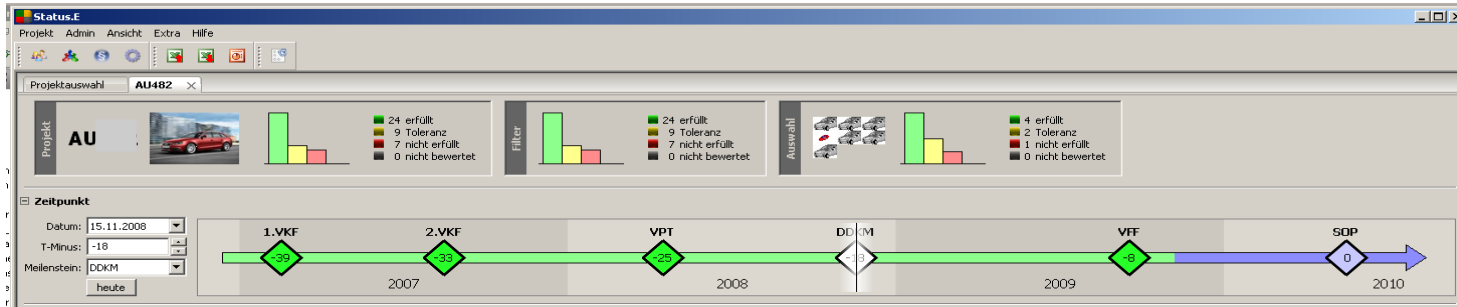
## Project Monitoring & Reporting

- Aggregation of assessments within CAE- team/department
- Mapping on project mile stones
- Monitoring of project status
- Report generation

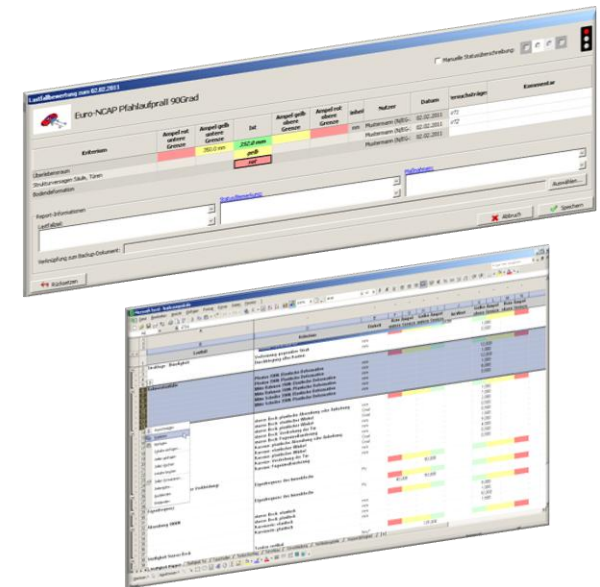


# Case Study 3: Project- and Status Monitoring

## Monitoring - Project status at a milestone

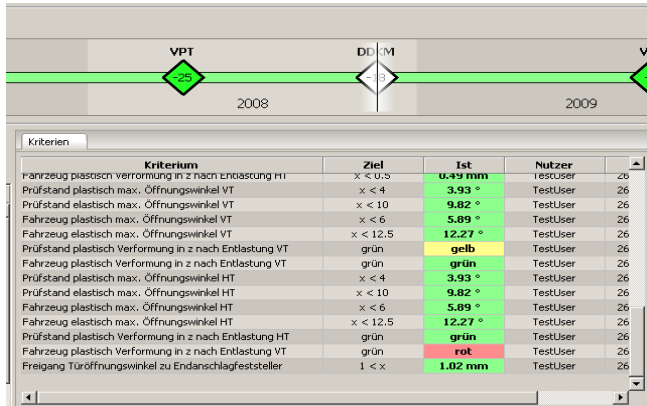


- Temporal allocation of simulation and experimental results on milestones
- Input of assessment data by
  - Interactive, GUI
  - Excel lists
  - Interfaces to other software applications



# Case Study 3: Project- and Status Monitoring

## ■ Assessment of a single status at a specific date



## ■ More features

### ■ Project Overview

- Assessment of development state on demand
- Who is responsible?
- Statistics (feasible/infeasible design properties)

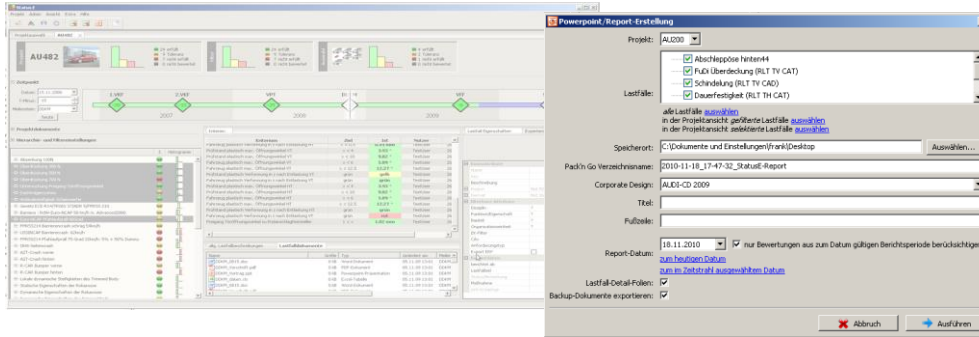
### ■ Rights management to secure visibility and modifications

### ■ Identification of critical project situations, comparison of projects



# Case Study 3: Report Generation

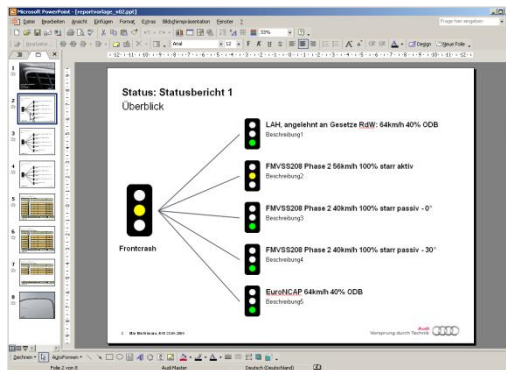
## ■ Reporting - automated generation of \*.ppt project reports



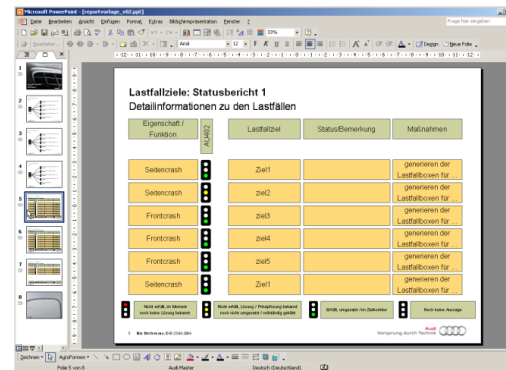
- Selection of scope and layout of reports
- Reports can contain links to more detailed information
- Integration of additional more detailed report documents



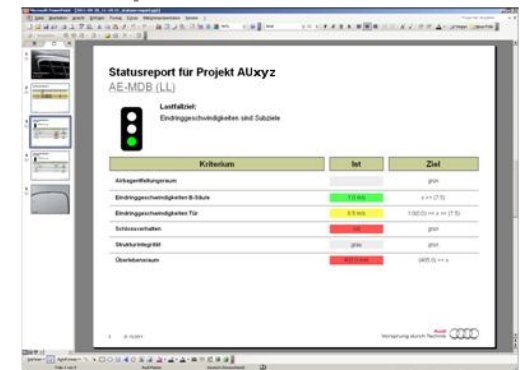
### overview of assessment



### all load cases of a discipline



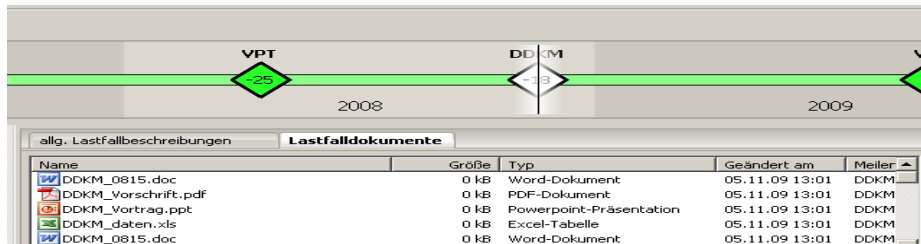
### specific load case



# Case Study 3: *Management of Documents*

## ■ Dedicated assessment documents and reports

- Attachment of documents to load cases, disciplines, projects



The screenshot shows a software interface with a timeline from 2008 to 2009. The timeline has three milestones: VPT (green diamond), DDKM (white diamond), and VPT (green diamond). Below the timeline is a table of documents.

Name	Größe	Typ	Geändert am	Meiler
<input checked="" type="checkbox"/> DDKM_0815.doc	0 kB	Word-Dokument	05.11.09 13:01	DDKM
<input checked="" type="checkbox"/> DDKM_Vorschrift.pdf	0 kB	PDF-Dokument	05.11.09 13:01	DDKM
<input checked="" type="checkbox"/> DDKM_Vortrag.ppt	0 kB	Powerpoint-Präsentation	05.11.09 13:01	DDKM
<input checked="" type="checkbox"/> DDKM_daten.xls	0 kB	Excel-Tabelle	05.11.09 13:01	DDKM
<input checked="" type="checkbox"/> DDKM_0815.doc	0 kB	Word-Dokument	05.11.09 13:01	DDKM

- Allocation of final reports to mile stones



# Summary

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- Innovative software products increase efficiency, reliability and sustainability in the vehicle development
- Introduced software systems have been developed with AUDI and VW in very close cooperation with engineering departments
- Increasing acceptance for data and process management systems in simulation departments

Thanks for your attention!

