



Experiences using a Process and Data Management System for CAE at AUDI

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Agenda

- ▶ Overview CAE process at AUDI
- ▶ Software Solution LoCo
- ▶ Modeling
- ▶ Current usage of LoCo
- ▶ Outlook



Overview CAE process at AUDI

CAD CAE

Design
DMU

Meshting

Preprocessing

Solving

Postprocessing



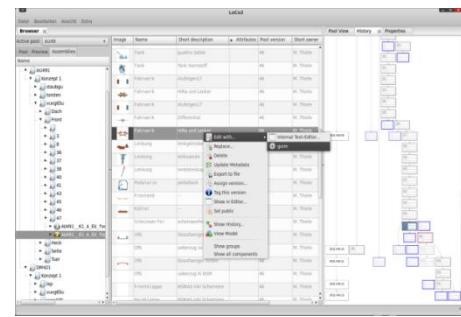
Design

Entwicklung

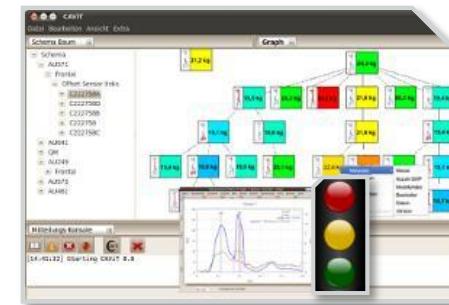
Monitoring



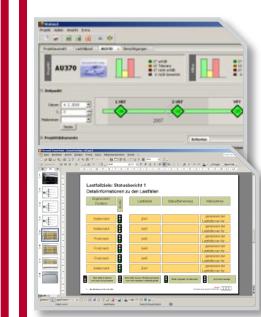
LoCo



CAE-Bench & CAViT



Status E.



CAT

Setup Prototypes

Test

Test Evaluation



-18



Agenda

- ▶ Overview CAE process at AUDI
- ▶ Software Solution LoCo
- ▶ Modeling Aspects
- ▶ Current usage of LoCo
- ▶ Outlook



Software Solution: LoCo

Software System for handling of Input data for simulations

- ▶ Target group
 - ▶ CAE - Engineers
 - ▶ Project managers



- ▶ Motivation
 - ▶ **Synergy**
 - ▶ **Transparency**
 - ▶ **Consistency**
 - ▶ **Time savings**
 - ▶ **Homogeneity**

common access to common components

continuous documentation of all processing steps

synchronization of all data throughout the team

automation of many processing steps

standardizing the way of work

Software Solution: LoCo

► Key-Features of LoCo – *Load Case Composer*

- ▶ Team Work
- ▶ Handling vast amounts of Simulations
- ▶ Offline Usage
- ▶ Reuse of Components
- ▶ Parameterization



Software Solution: LoCo

► Key-Features of LoCo – *Load Case Composer*

► Team Work

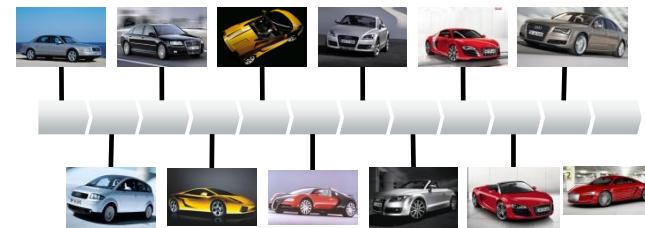
► Handling vast amounts of Simulations



► Offline Usage

► Reuse of Components

► Parameterization



Software Solution: LoCo

► Key-Features of LoCo – *Load Case Composer*

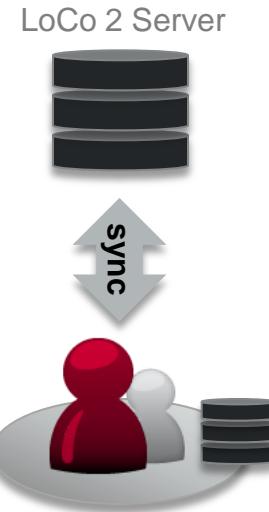
► Team Work

► Handling vast amounts of Simulations

► Offline Usage

► Reuse of Components

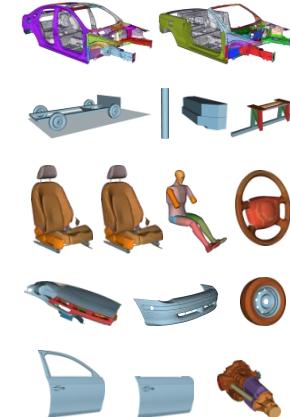
► Parameterization



Software Solution: LoCo

- ▶ Key-Features of LoCo – *Load Case Composer*

- ▶ Team Work
- ▶ Handling vast amounts of Simulations
- ▶ Offline Usage
- ▶ Reuse of Components
- ▶ Parameterization



Software Solution: LoCo

► Key-Features of LoCo – *Load Case Composer*

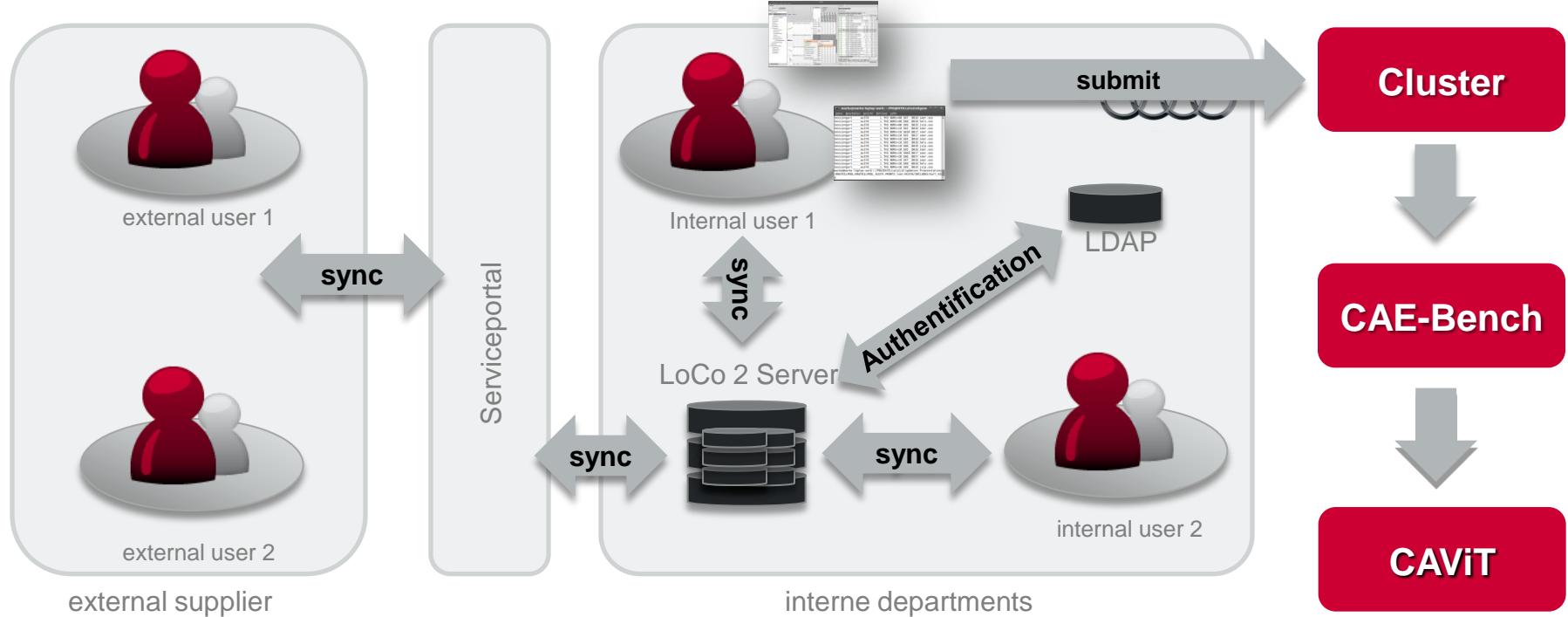
- Team Work
- Handling vast amounts of Simulations
- Offline Usage
- Reuse of Components
- Parameterization



airbag TTF	15ms
vent area	15ms
sheet thickness	1.2mm
calc time	100.1
friction	0.1

Software Solution: LoCo

► Workflow, Teamwork and Synchronization



Sync

decentralized

- ▶ Central data storage, but synchronization with local cache
- ▶ Offline handling of components (**RichClient**)

Offline

performance

- ▶ Users/Teams are independent of servers and infrastructure
- ▶ Users work with local data
- ▶ Better performance while using standard preprocessing tools

Software Solution: LoCo

- Reuse of components, parameterization and optimization



» Assembly of multiple derivates / loadcases

Coupé



US-NCAP Seite



US-NCAP Front



Cabriolet



» Setup of parameter studies and optimizations

- Define parameter, range and objective
- Build multiple models at a stroke of a key



Software Solution: LoCo

► Innovative rich client technology for optimal performance

The screenshot displays the LoCo2 software interface, which is a rich client application designed for optimal performance. The interface is organized into several panels:

- Left Panel (Browser):** Shows a hierarchical tree structure of components and pools. The active pool is AU49. Key nodes include AU491, Konzept 1, M. Liebscher, T. Landschoff, and M. Thiele. Under M. Thiele, there are sub-nodes like Dach, Front, and various numbered components (3, 8, 36, 37, 38, 40, 41, 43, 45, 46, 47). Other sections include US-NCAP 56 and EU-NCAP 56.
- Central Panel (Table View):** A grid-based table showing component details. The columns include Image, Name, Description, Version, and Author. Some rows are partially visible, such as "Fahrwerk Alufelgen17", "Fahrwerk Differential", and "Fahrwerk HiRa und Lenker".
- Right Panel (Tree View):** A hierarchical tree diagram showing the structure of the components. Nodes are represented by rectangles with numbers (e.g., 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 46, 47, 48, 49, 50, 51) and some are highlighted in red (e.g., 46, 47, 48).
- Bottom Panel (Timeline):** A timeline showing project milestones: 2011 KW 09, 2011 KW 10, 2011 KW 11, 2011 KW 12, and 2011 KW 13.

A callout box highlights the word "recognizability" and lists two points:

- usability similar to standard tools
- same look and feel for everybody

A context menu is open over the "Fahrwerk HiRa und Lenker" row in the table, listing options such as "Edit with...", "Internal Text-Editor...", "gvim", "Replace...", "Delete", "Update Metadata", "Export to file", "Assign version...", "Tag this version", "Show in Editor...", "Set public", "Show History...", and "View Model".



Software Solution: LoCo

► Innovative rich client technology for optimal performance

The screenshot displays the LoCo2 software interface, which is a rich client application for managing engineering components. The main window is divided into several panels:

- Browser Panel:** Shows the active pool "AU49" and its contents. It includes a tree view of components like "Konzept 1", "M. Liebscher", "T. Landschoff", and "M. Thiele", along with specific parts such as "Dach", "Front", and various mechanical components.
- Table View:** A grid showing detailed information for each component, including "Image", "Name", "Short description", "Attributes", "Pool version", and "Short owner". One row is selected for "Fahrwerk" (HiRa und Lenker).
- Context Menu:** A dropdown menu is open over the selected "Fahrwerk" row, listing options like "Edit with...", "Replace...", "Delete", "Update Metadata", "Export to file", "Assign version...", "Tag this version", "Show in Editor...", "Set public", "Show History...", and "View Model".
- Properties Panel:** Located at the top right, it contains tabs for "Pool View", "History", and "Properties".
- Assembly Tree:** On the right side, a hierarchical tree diagram shows the assembly structure. Components are represented by small icons, and their relationships are shown by connecting lines. Some components are highlighted with red or blue boxes, and specific nodes are labeled with identifiers like "30", "31", "32", "33", "34", "35", "36", "37", "38", "39", "40", "41", "42", "43", "44", "45", "46", "47", "48", "49", "50", "51", and dates like "2011 KW 09" through "2011 KW 13".

clear arrangement

- listing of all relevant components
- thumbnails for easy perception



Software Solution: LoCo

► Innovative rich client technology for optimal performance

The screenshot shows the LoCo2 software interface. On the left is a tree-based browser showing project structures like AU49, Konzept 1, and various components. The main area displays a table of components with columns for Image, Name, Short description, Attributes, Pool version, and Short owner. A context menu is open over a row for a 'Fahrwerk' component, listing actions such as 'Edit with...', 'Internal Text-Editor...', 'gvm', 'Replace...', 'Delete', 'Update Metadata', 'Export to file', 'Assign version...', 'Tag this version', 'Show in Editor...', 'Set public', 'Show History...', and 'View Model'. A callout box highlights the 'intuitive' nature of these 'context sensitiv actions'. The background shows a hierarchical assembly structure.

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

Software Solution: LoCo

► Innovative rich client technology for optimal performance

The screenshot displays the LoCo2 software interface, which is a rich client application for managing engineering data. The interface is divided into several panels:

- Browser Panel (Left):** Shows the active pool "AU49" and its contents. A tree view shows nodes like "Konzept 1", "M. Liebscher", "T. Landschoff", and "M. Thiele". Below this is a list of components such as "Dach", "Front", "3", "8", "36", "37", "38", "40", "41", "42", "43", "45", "46", "47", "US-NCAP 56", and "EU-NCAP 56".
- Table View (Center):** A grid showing component details like "Name", "Short description", "Attributes", "Pool version", and "Short owner". One row is highlighted for "Scheinwerfer". A context menu for this row includes options like "Show History...", "View Model", "Show groups", and "Show all components".
- History Panel (Right):** Displays a timeline of changes across different weeks (2011 KW 09 to 2011 KW 13). It shows a hierarchical tree of changes, with specific items like "46" and "47" highlighted in red.
- Properties Panel (Top Right):** Shows properties for selected items, including "Pool View", "History", and "Properties" tabs.

A callout box highlights the "traceability" feature, listing the following benefits:

- consistent documentation of each action
- comprehensive visualization of history
- cronologic presentation

Software Solution: LoCo

► Innovative rich client technology for optimal performance

The screenshot displays the LoCo2 software interface, which is a rich client application for managing engineering data. The main window is titled "LoCo2".

Left Panel (Browser): Shows the "Active pool: AU49" and a tree view of components. Key nodes include "AU49", "Konzept 1", "M. Liebscher", "T. Landschoff", and "M. Thiele". Under "M. Thiele", there are sub-nodes like "Dach", "Front", and several "Lenkung" components.

Middle Panel: A table view of parts in the pool. One row for "Fahrwerk" is selected and has a context menu open:

- Edit with...
- Replace...
- Delete
- Update Metadata
- Export to file

Right Panel (Pool View): A detailed view of the "Barriere" component. It shows a table with columns: Component, Images, Comments, Reports, and BOM. The "BOM" section contains the following data:

S	D	PID	PName	Thickness	Total Mass
✓	9807001	Deckplatte Stahl	...	20.00	125.600
✓	9807999	RIGIDWALL	...	1.00	68.688
✓	9807002	Anschlussplatte Stahl	...	1.20	7.536
✓	9999000	Part Versionsnummer	...	1.00	3.915
✓	9808001	STAHL BAR Messbalken mit...	...	-	2.779
✓	9805001	DECKBLECH VORN	...	0.81	1.319
✓	9805002	DECKBLECH OBEN	...	0.81	1.040
✓	9805003	DECKBLECH UNTEN	...	0.81	1.040
✓	9806001	BUMPER-DECKBLECH	...	0.81	0.720
✓	9899003	TIED Part Klebekontakt Barr...	...	-	0.000
✓	9899002	TIED Part Klebekontakt Bu...	...	-	0.000
✓	9899001	TIED Part Klebekontakt Bu...	...	-	0.000
✗	9801001	BLOCK	...	-	-
✗	9802001	BUMPER	...	-	-

Bottom Panel: Displays summary information: "Number of parts: 14", "Total: ?", and "Total (Selection): 1.3 kg (S: 1.319 kg / N: 0.000 kg), dM: +0.000 kg". Buttons for "Search", "apply BOM", and "reset BOM" are also present.



Software Solution: LoCo

► Innovative rich client technology for optimal performance

The screenshot displays the LoCo2 software interface, which is a rich client application for managing engineering data. The main window is divided into several panes:

- Browser:** Shows the active pool "AU49" and its contents. A tree view shows categories like "Konzept 1", "M. Liebscher", "T. Landschoff", and "M. Thiele". Under "M. Thiele", there are sub-folders "Front" and "US-NCAP 56", and files numbered 3 through 47.
- Table View:** A grid showing components with columns for Image, Name, Short description, Attributes, Pool version, and Short owner. Components listed include "Tank", "Fahrwerk" (Alufelgen17, HiRa und Lenker), "Lenkung", "Pedalerie", "Frontend", "Kühler", and "Scheinwerfer".
- Context Menu:** A context menu is open over the "Fahrwerk" row, listing options such as "Edit with...", "Internal Text-Editor...", "gvim", "Replace...", "Delete", "Update Metadata", "Export to file", "Assign version...", "Tag this version", "Show in Editor...", "Set public", and "Show History...".
- Component Details:** A detailed view for the selected "Fahrwerk" component, titled "Fahrwerk" and owned by "HiRa und Lenker". It includes tabs for "Component", "Images", "Comments", "Reports", and "BOM". Below the tabs are four small thumbnails of the component from different angles.
- Preview:** A large preview window on the right shows a 3D rendering of a car's front suspension and wheel assembly, highlighting specific parts in red.

A callout box highlights the "previews / thumbnails" feature, with the following text:

- integrated generation of component pictures
- automatic tracking of changed parts

Agenda

- ▶ Overview CAE process at AUDI
- ▶ Software Solution LoCo
- ▶ Modeling Aspects
- ▶ Current usage of LoCo
- ▶ Outlook



Modeling Aspects

- ▶ A uniform model structure for all departments

The screenshot shows a software interface with a toolbar at the top and two main panes below. The left pane is a 'Browser' window titled 'AU37' containing a hierarchical tree of components under 'AU49'. The right pane is a table titled 'LoCo2' with columns for 'Image', 'Name', 'Short description', and various attributes like 'Basis', 'Derivat', 'Fahrzeug', etc.

Image	Name	Short description	Basis	Derivat	Fahrzeug	Filetyp	Geschwindigkeit	Identifikation	Lastfaktor	OEM	Position	Projekt	Region	Tiefe	Version	Creation time	Short	
Datenbanken	Datenbanken															14	13.05.2011 09:10	M. Hasselbusch
Fahrzeug	Fahrzeug															66	04.05.2011 14:41	G. Geißler
Header	Header															6	18.03.2011 09:35	M. Thiele
Tools	Tools															16	13.05.2011 12:52	M. Thiele

- ▶ Components are at the same place for everybody
- ▶ Not everybody can edit any component (e.g. Materials)
- ▶ Responsible persons are in charge of
 - ▶ Material
 - ▶ Barriers
 - ▶ Impactors
 - ▶ Engineers
 - ▶ Dummies
 - ▶ ...
- ▶ Joint components where ever possible

Modeling Aspects

- ▶ A uniform model structure for all departments

► Databases
► Material
► Impactors
► Barriers
► Driving surface

Name	Short description	Barrier	Derivat	Disziplin	Fahzeugzone	FileType	Geschwindigkeit	Identifier	Lastfallart	OEM	Position	Projektnummer	Region	Version	Creation time	Short	
Barriere	Dachstempel	d	-	-	d	inc	-	-	-	AU	1	49	-	-	4	03.05.2011 11:17	G. G
Barriere	Dachstempel rechts	d	--	d	inc	--	--	--	AU	3	49	--	--	5	04.05.2011 17:36	G. G	
Barriere	ODB v40 Left	o	--	f	inc	--	--	--	AU	--	49	--	--	2	08.04.2011 17:34	M. T	
Barriere	ODB v40 Master	o	--	f	inc	--	--	--	AU	--	49	--	--	3	03.05.2011 11:28	G. G	
Barriere	Wand	w	--	f	inc	56	--	u	AU	--	49	--	--	2	08.04.2011 17:34	M. T	
Barriere	Wand Master	w	--	f	inc	56	--	u	AU	--	49	--	--	3	03.05.2011 11:32	G. G	
Barriere	AZT 10 Grad f	z	--	f	inc	15	--	z	AU	--	49	--	l	2	08.04.2011 17:34	M. T	
Barriere	AZT 10 Grad	z	--	f	inc	15	--	z	AU	--	49	--	l	3	03.05.2011 11:47	G. G	
Barriere	NHTSA-Heck Wagen V401	h	--	h	inc	80	--	f	AU	--	49	--	r	2	08.04.2011 17:34	M. T	
Barriere	NHTSA-Heck	h	--	h	inc	80	--	f	AU	--	49	--	r	2	08.04.2011 17:34	M. T	
Barriere	NHTSA-Heck Master	h	--	h	inc	80	--	f	AU	--	49	--	r	3	03.05.2011 11:57	G. G	
Barriere	AZT 10 Gr Heck Master	y	--	h	inc	15	--	z	AU	--	49	--	l	3	03.05.2011 11:59	G. G	
Barriere	AZT 10 Gr Heck f	y	--	h	inc	15	--	z	AU	--	49	--	l	2	08.04.2011 17:34	M. T	
Barriere	RCAR BUMPER Defoelem	r	--	f, h	inc	10	--	--	AU	--	49	--	m	2	08.04.2011 17:34	M. T	
Barriere	RCAR BUMPER Master	r	--	f, h	inc	10	--	--	AU	--	49	--	m	3	03.05.2011 11:51	G. G	
Barriere	EEVC Defoelem	e	--	s	inc	50	--	e	AU	--	49	--	--	5	08.04.2011 17:34	M. T	
Barriere	EEVC Master	e	--	s	inc	55	--	j	AU	--	49	--	--	e	--	--	
Barriere	EEVC Wagen	e	6	s	inc	50	--	--	AU	--	73	EU	--	e	6	--	--
Barriere	EEVC Wagen	e	6	s	inc	55	--	--	AU	--	73	JP	--	e	6	--	--
Barriere	EEVC Master	e	--	s	inc	50	--	e	AU	--	49	--	--	3	03.05.2011 12:02	G. G	
Barriere	EEVC Wagen	e	--	s	inc	55	--	j	AU	--	49	--	--	3	03.05.2011 12:40	G. G	

Modeling Aspects

Common modeling practice

► Goal

- ▶ Interchanging includes without the need of adaption
- ▶ Pushing cooperative use of common parts in simulations

► Motivation

- ▶ Less effort
- ▶ Less cost
- ▶ Faster responses

→ just agreement on numbering conventions will not do the job!



Modeling Aspects

How to achieve a common modeling practice?

► Numbering conventions

- The most important aspect and a good start, but left alone this will not suffice...

► Isolating individual components (Includes)

- Most important Rule:

A component shall never reference to something that is not defined within that same component!

► Conventions for standardized interfaces

- Connectivity
- Contact

► Clear rules for modeling

- How to use barriers
- How to do mass trim
- ...



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Current usage of LoCo

240 registered users

► **AUDI**

- ▶ structural crash
- ▶ cockpit, seat, door trim
- ▶ occupant safety, sensory, out of positon

► **VW**

- ▶ in preparation

► **SEAT**

- ▶ structural crash
- ▶ occupant safety

► **VW-Osnabrück**

- ▶ structural crash for AUDI

► **Italdesign**

- ▶ structural crash
- ▶ occupant safety, cockpit

► **External suppliers**

individual users per month

counted for last 31 days



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Outlook

- ▶ Enforcing quality management
 - ▶ more checks
 - ▶ more restricted areas (e.g. barriers)
- ▶ Establishing a common project infrastructure
 - ▶ Throughout various projects
 - ▶ Including different disciplines
- ▶ Further increasing usability and performance of the LoCo rich client
- ▶ Using it together with the other brands of VW for platform development
- ▶ Support for meshing





Vielen Dank.