

LoCo

An Innovative Process and Team Data Management

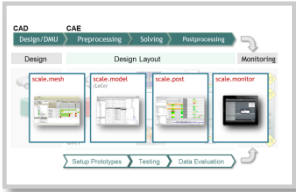
Marko Thiele, T. Landschoff
Heiner Müllerschön
Martin Liebscher

May 2016

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Agenda



Introduction LoCo and SCALE.sdm

- Software Components
- Key Features
- Unique selling points



Decentralization of Development

- Integration of suppliers and engineering providers
- Connecting multiple locations
- System architecture, operations



Recently added

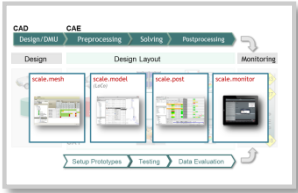
- Check Infrastructure
- Multi run setups
- Advanced Search
- Copy'n'Paste
- Offline Sync
- Multi stage Setups



In development

- New Compression techniques
 - **Input Data:** Data Deduplication
 - **Output Data:** Support for SDM-Zip
- Live Mode
- CAD/Meshing Integration
- Integration with collaboration systems
- UI redesign of SDM clients

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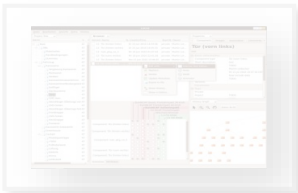
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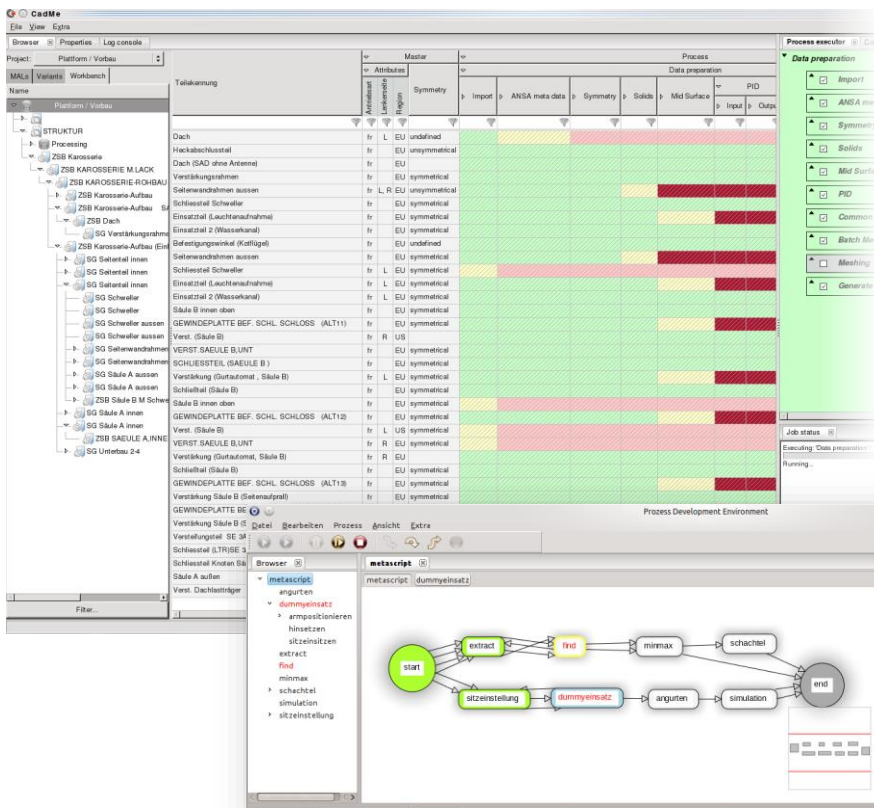
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■ CAD Interface

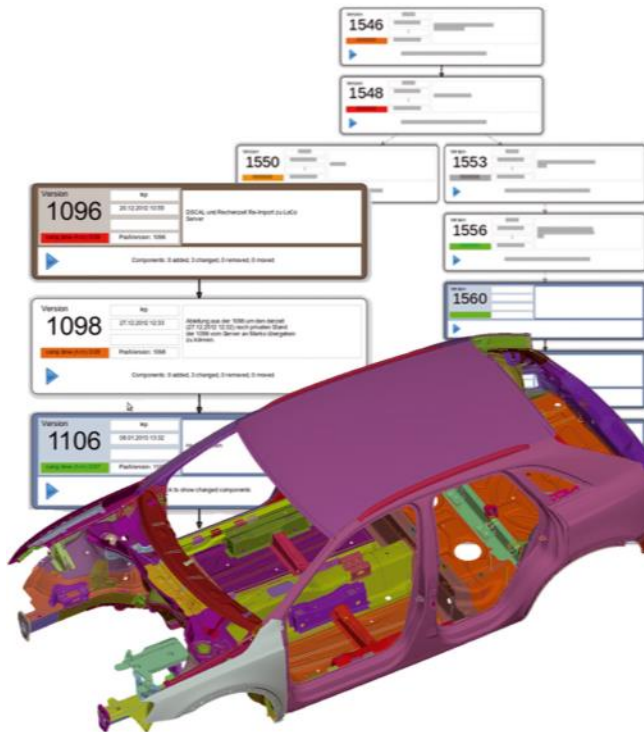
- Update and check of new CAD-versions with meshed parts

■ Meshing Process

- Support of meshing process
- Provision of data
- Flexible adaptable process
- Integrated tools for process modeling
- Integration of preprocessors (*ANSA, Hypermesh, ...*)

■ Data Management

- Synchronization of work flow for all participants (*internal and external*)
- Changes appear instantly for all team members
- Role and right management

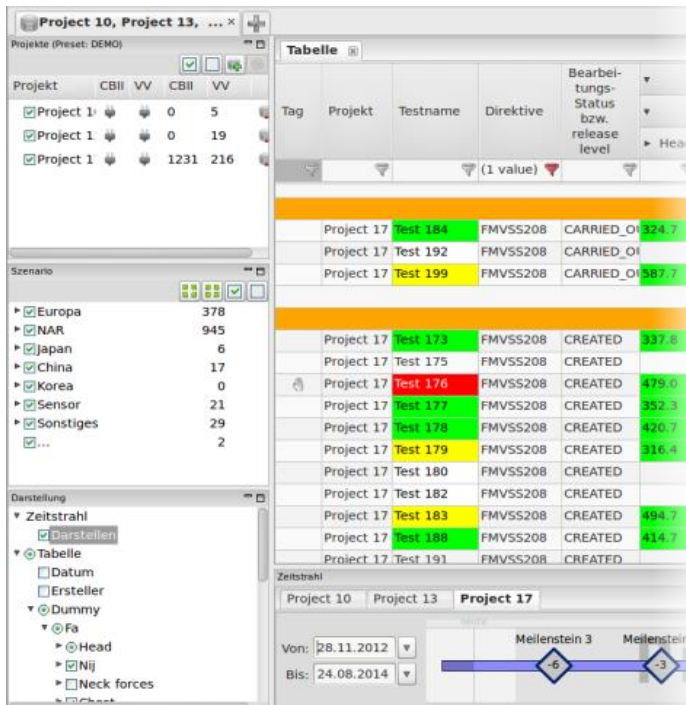
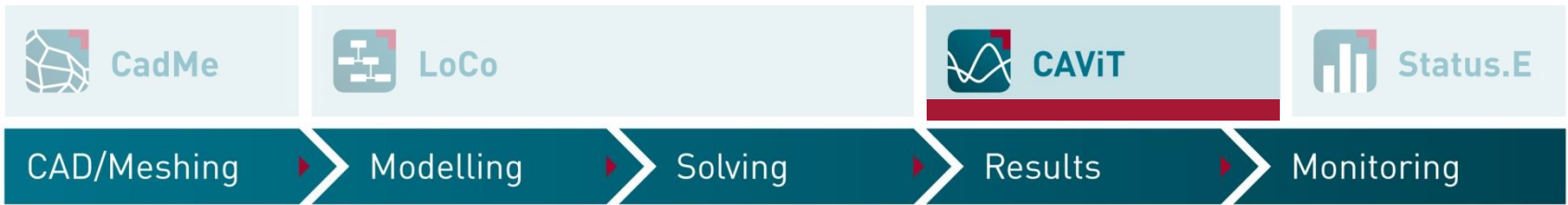


■ Simulation Data- / Variant Management

- Workbench for Simulation Engineers
- Unique RichClient/Offline-concept with sync-mechanism (*internal/external*)

■ Workflows / Features

- Integration of arbitrary CAE processes
- Solver: PAM-Crash, LS-DYNA, Nastran, Abaqus, ...
- Job submit and monitoring
- Optimization, robustness, DOE, ...
- Quality checks of models
- Advanced security features
 - Two factor authentication
 - Encryption
 - Sofisticated roles and rights management
- Distributed, collaborative work environment
-

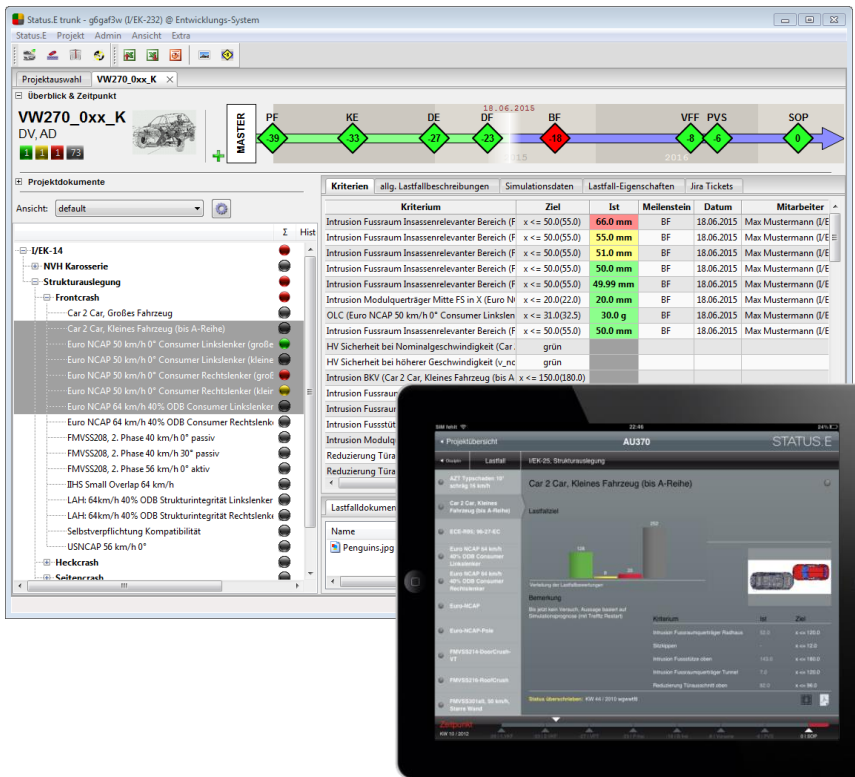
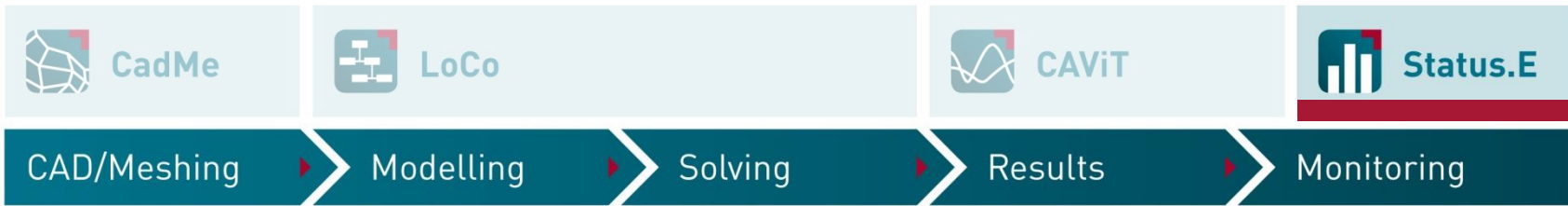


■ Post Data Management

- Procurement and provision of outcome data from **simulation** and **experiment**
- Comparison and visualization of simulation and experimental data

■ Features

- Assessment of simulation and experimental results (*szenario based*)
- Easy integration of any application and processes (*Plugins for e.g. Animator, Falcon,..*)
- Automatic report generation
- ...



■ Requirements management

- Management of project and milestone specific Requirements
- Automatic generation of specifications
- Change management

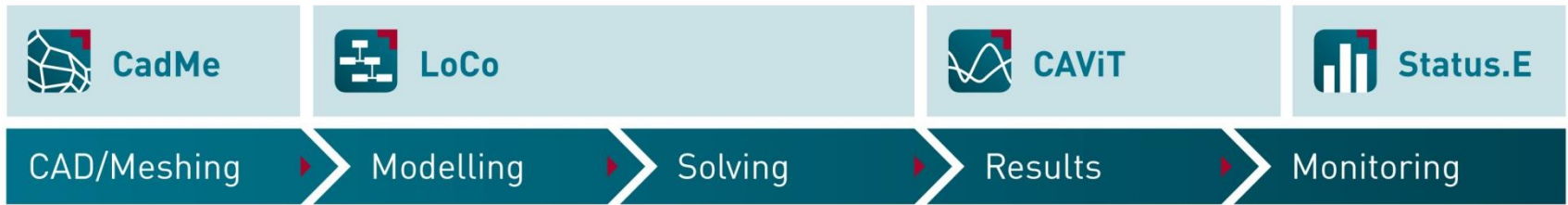
■ Status Monitoring

- Monitoring of the performance of simulation and test requirements with respect to project milestones
- Aggregated review over CAE-disciplines and simulation departments

■ Documentation

- Integrated document management system
- Automatic generation of status reports (ppt, doc, pdf)

SCALE.sdm: *Software Solution for Management of Simulation Data*



SCALE

■ Focused

- One dedicated App for each user group
- Reduced to meet the requirements of the use cases in question

■ Flexible

- Software components can be combined as required
- Easy integration of new disciplines and processes

■ Integrated

- All software components work seamless together
- Performant integration of pre and post processors

■ Decentralized

- Unique synchronizing technologies for distributed teams

■ Scalable

- Business logic close to the users
- Advanced compression techniques to reduce bandwidth and storage requirements

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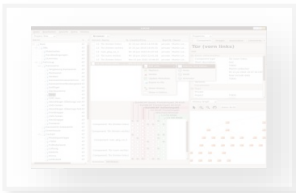
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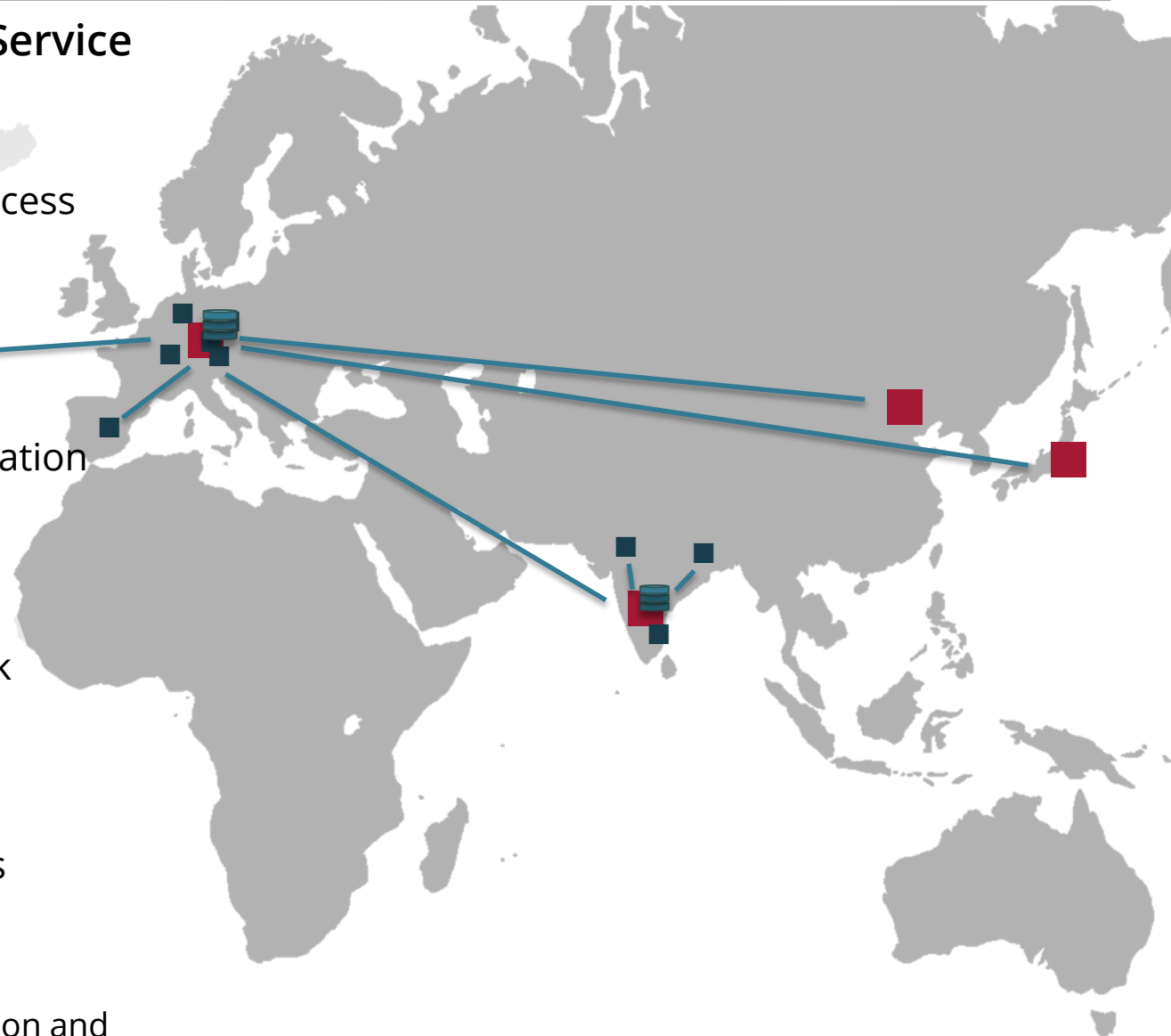
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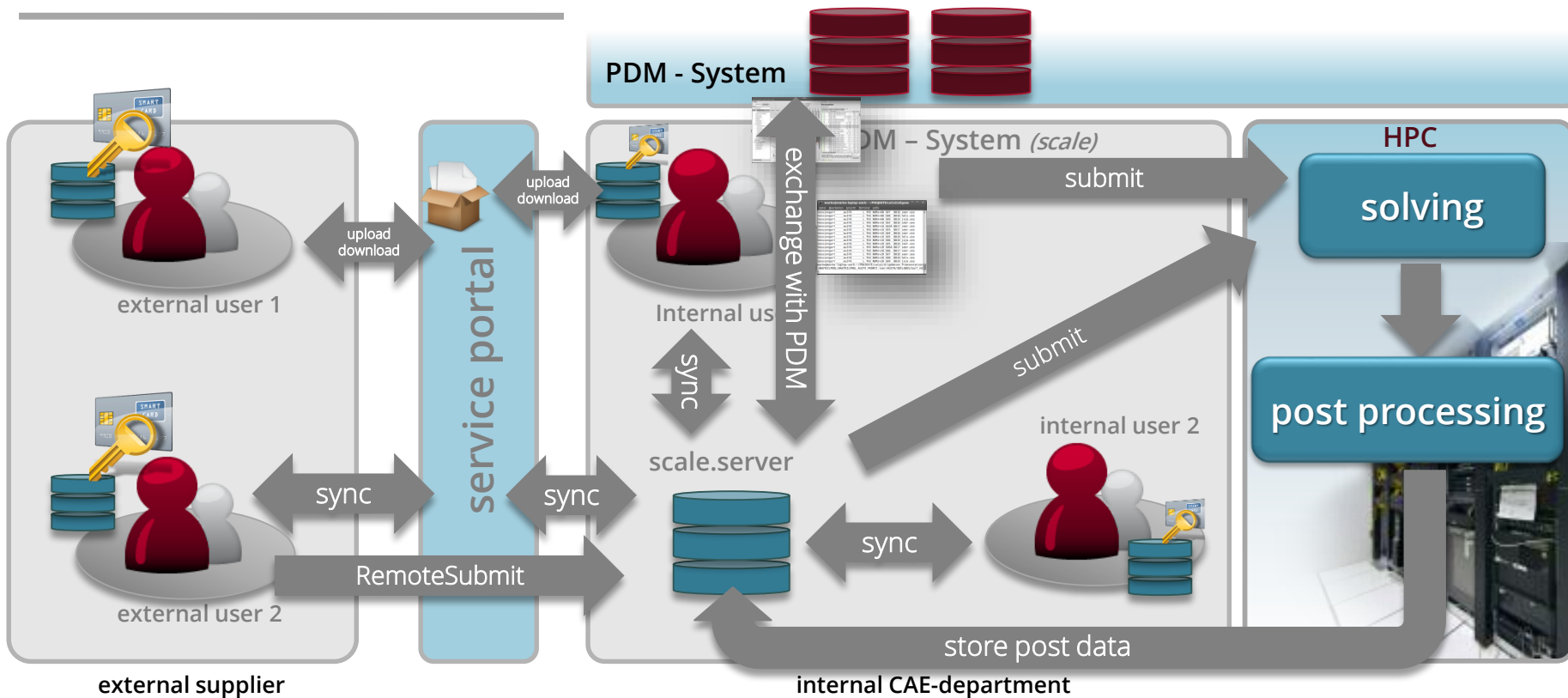
SCALE.sdm: *scaling development by decentralization*

■ Sites, Suppliers and Service Partners

- Direct integration in CAE development process
- Uniform working environment
- Automatic synchronization of relevant data
- Good performance even for poor network bandwidth
- Complying with high security requirements
 - encrypted storage
 - encrypted transfer
 - two factor authentication and encryption



scale.SDM: *Workflow, Teamwork and Synchronization*



Sync *decentralized*

- Central data storage, synchronization with local workstations (*cloud like infrastructure*)
- Encrypted transfer, encrypted storage (*two factor authentication and encryption*)
- Offline handling of data (*RichClient*)

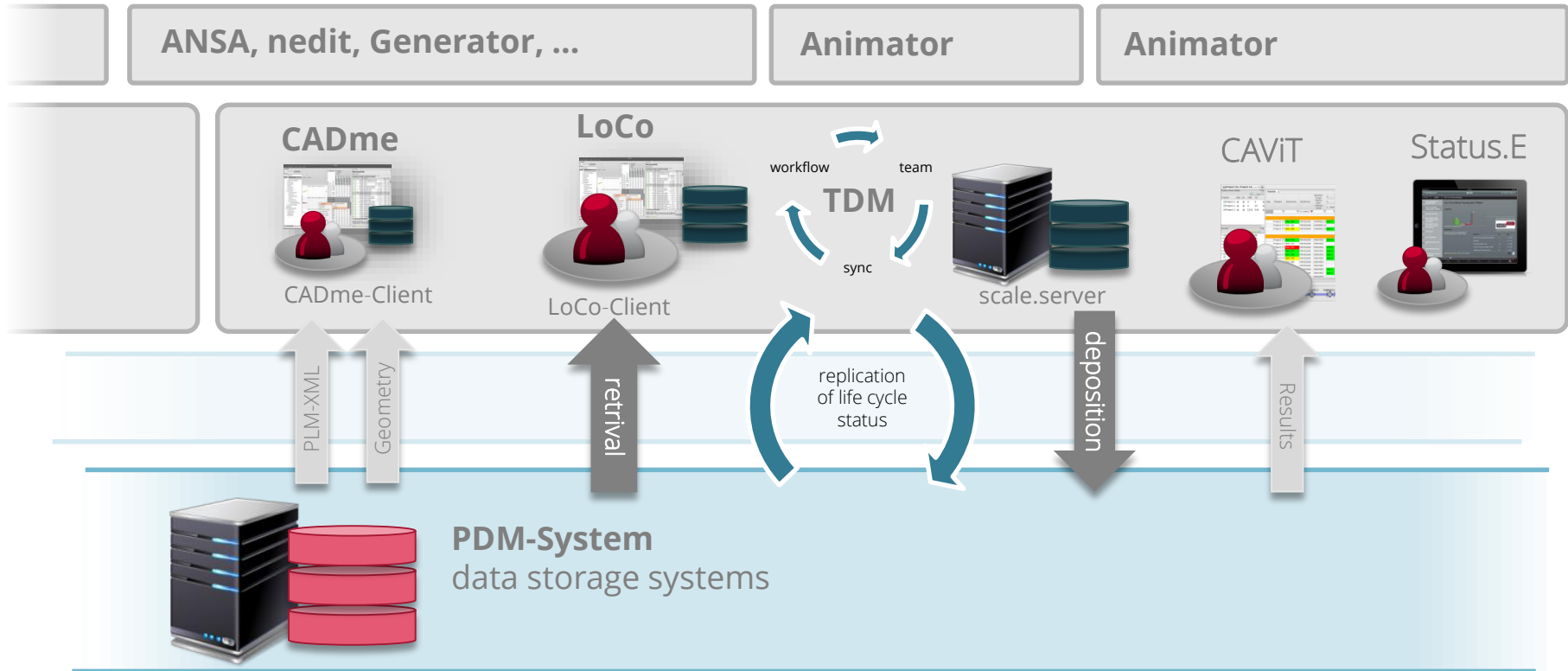
Offline / Online *performance*

- Users/Teams are independent of servers and infrastructure
- Users work with local data
- Good performance while application of preprocessing tools

Integration

- Integration with existing PDM Infrastructure as TDM-System (*Team Data Management*)

SCALE.sdm: *Integration with PDM Systems* (Team Data Management)



- **Automatic / Integrated data deposition and retrieval from connected Storage and PDM-Systems**
 - Automatic deposition of important variants from LoCo
 - Easy retrieval of stored variants
 - Usage of system APIs for access between TDM and PDM/Storage Systems
- **Automatic cleanup: storage space in scale.server might be restricted** *(by time and or size)*
- **Replication of life cycle status** *(reference, status, ...)*

SCALE.sdm: *Versioning / Documentation*

■ Every object is versioned

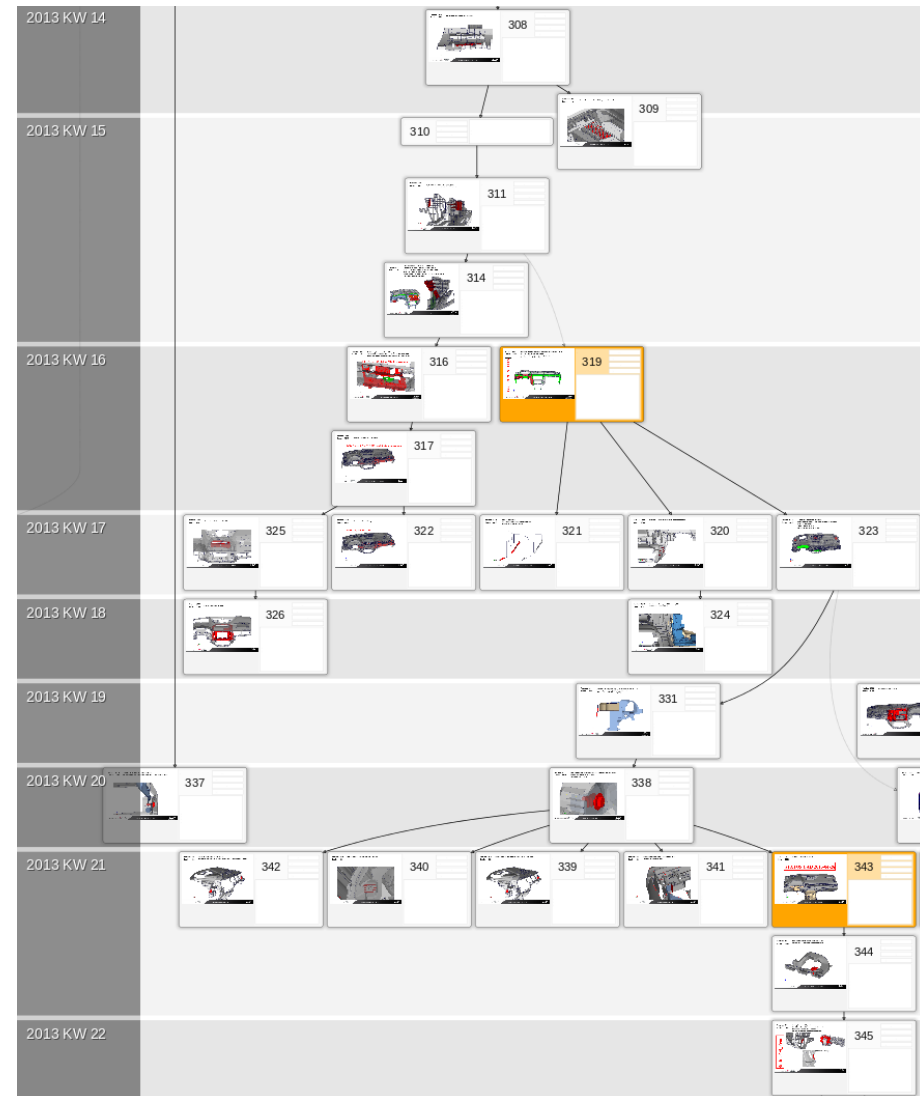
Simulation Runs
Scripts Includes Folders
Meshes Parameters

■ Motivation

- Simultaneous work on the same files
- Each action is documented
- Powerful features to merge changes

■ Audit trail and Versioning

- Audit trail represented by data structure
- Versioning extends audit trail over time
- The audit trail becomes multi dimensional



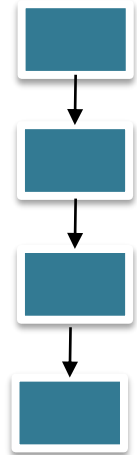
SCALE.sdm: *Versioning / Documentation*

■ „Lock Modify Write“ (*classical PDM Systems*)

- Objects are locked if one person is working with them
- After the work is done users need to check in the changed items
- Problematic in situations where team members need to work independently
- No simultaneous working with the same objects
- Instant access to changes of coworkers
- Always consistent data (*no merging of data required*)



CADme

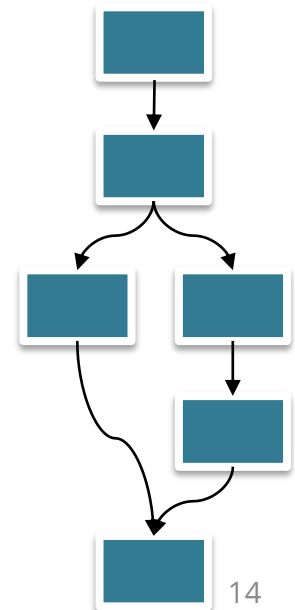


■ „Copy Modify Merge“ (*LoCo, git, svn, ...*)

- Objects can be used instantly (*on changes a copy will be created*)
- No „check in“ – „check out“ necessary
- Users can act independently from other users and servers
- Simultaneous work on the same objects is possible
- It's possibly required to merge branches

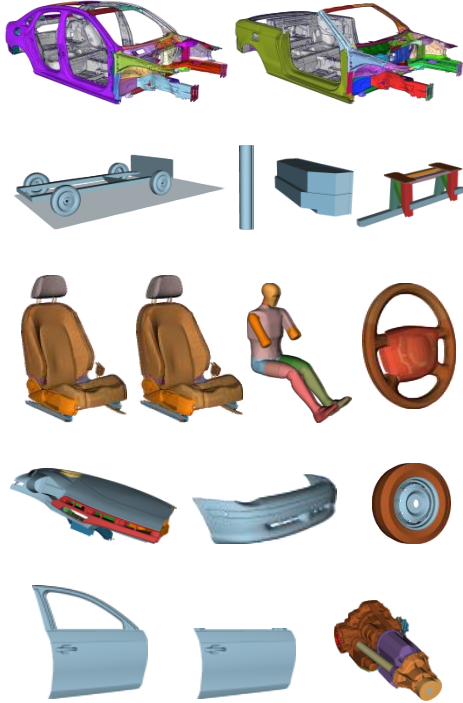


LoCo



SCALE.sdm: *Variant management*

component pool



component parameters

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

➤➤ Assembly of multiple load cases and derivatives

Coupé



Convertible



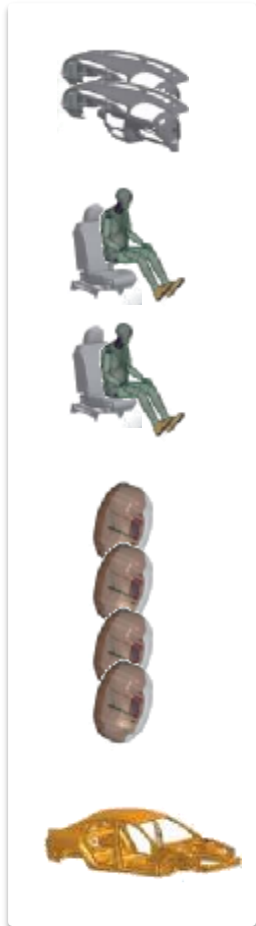
➤➤ Setup of optimizations and DOEs

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



SCALE.sdm: *Variant management*

Pool



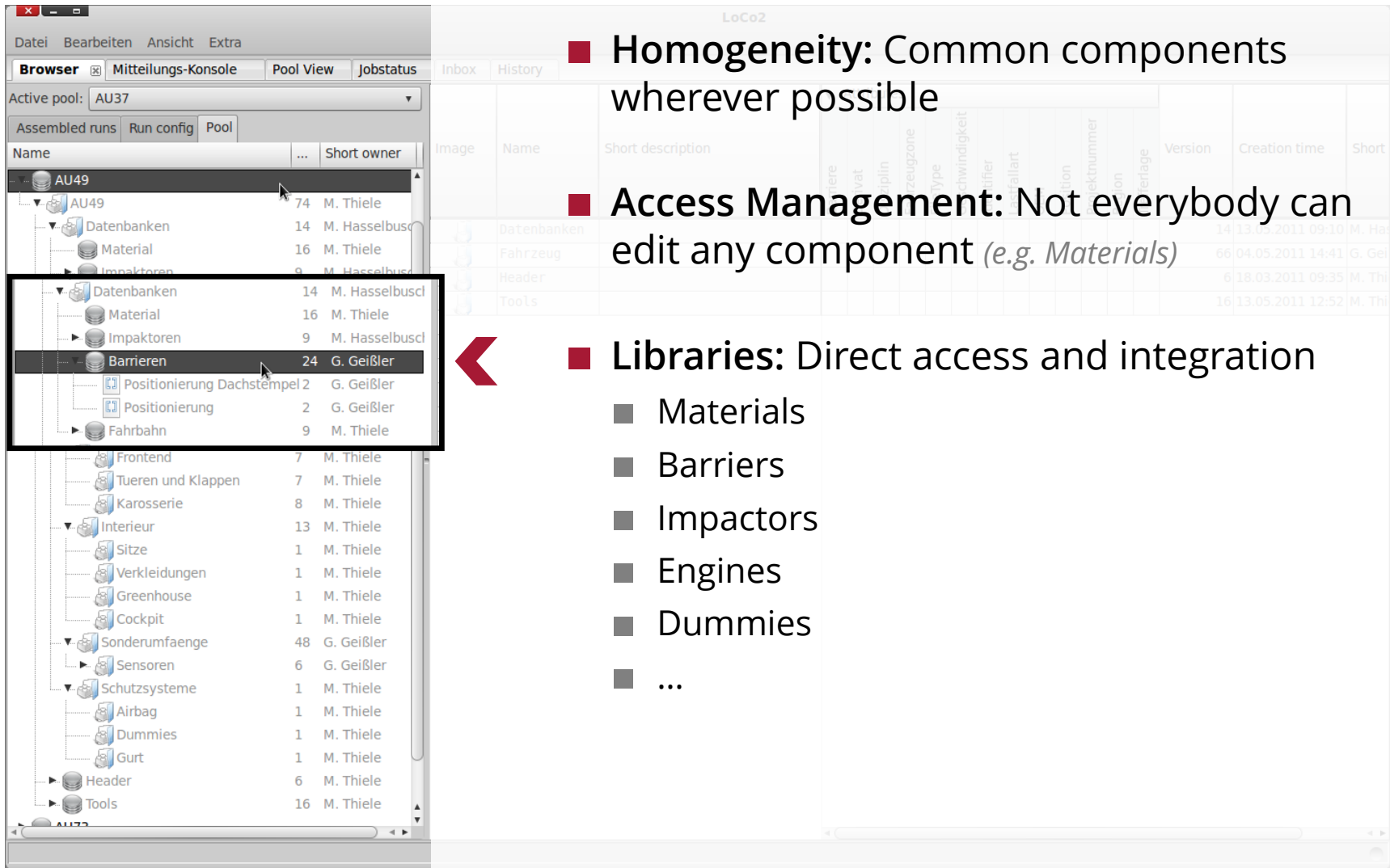
Region	Zone	Side	Dummy
Europe			



Attribute based assignment

- Definitions assigned to components
 - Region: EU, US
 - Components are used only for US or EU
 - without attribute:
 - Components are used always
- Same approach for parameters
- Changes get automatically applied to all relevant simulations
- Easy creation of new setups
- Users need to get used to it

SCALE.sdm: *Project setup*



The screenshot shows the SCALE.sdm interface. On the left, a tree view displays the project structure for 'AU37'. The 'Barrieren' component is highlighted with a red box. On the right, a table lists components with columns for Name, Short description, Version, Creation time, and Short. A red arrow points from the 'Barrieren' component in the tree to the table.

Name	Short description	Version	Creation time	Short
Datenbanken		14	13.05.2011 09:10	M. Ha
Fahrzeug		66	04.05.2011 14:41	G. Gei
Header		6	18.03.2011 09:35	M. Thi
Tools		16	13.05.2011 12:52	M. Thi

■ **Homogeneity:** Common components wherever possible

■ **Access Management:** Not everybody can edit any component (*e.g. Materials*)

■ **Libraries:** Direct access and integration

- Materials
- Barriers
- Impactors
- Engines
- Dummies
- ...

■ Uniform model structure for all departments

SCALE.sdm: *Job submit and monitoring*

■ Job Submit

Instant start of jobs on the HPC-cluster

- Decks are assembled directly in the datacenter at the HPC-cluster
- A minimum of data have to be transferred
- Jobs start instantly

■ Job Control

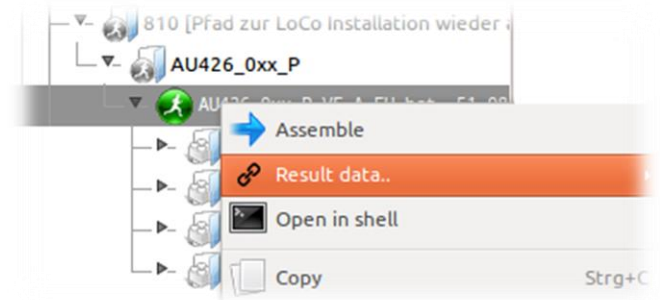
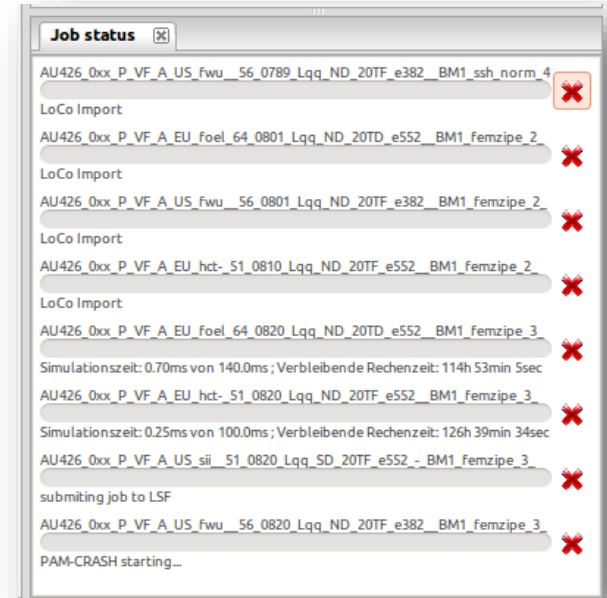
Monitoring job progress on the HPC-cluster

- Continuous feedback on job progress
- Stopping of jobs

■ Result Access

Retrieving and accessing result data

- Automatic download of result data
- Access to result data of other users
- Direct integration with postprocessors



scale.SDM: *Example for operation*

- ~400 active users each month (*~750 registered total...*)
- server is self hosted by client
 - slim server architecture, low server load, easy setup
 - service friendly operations
 - no high availability required due to software architecture (*offline capable clients, decentralized synchronization*)
 - allows for maintenance during regular working hours
 - complying with state of the art security standards
- ~850.000 simulations assembled during last 4 years (*~estimated 400.000 jobs submitted to HPC*)
 - the entire history of how each simulation that has been created can be browsed down to the history of each include
 - any single simulation or include can be extracted at any time from the system



- just ~4TB of total storage occupied on server for all simulation input data
 - achieved by file level data deduplication
 - In the future compression levels can be increased by fact. 4 (*block level data deduplication*)





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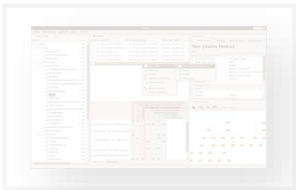
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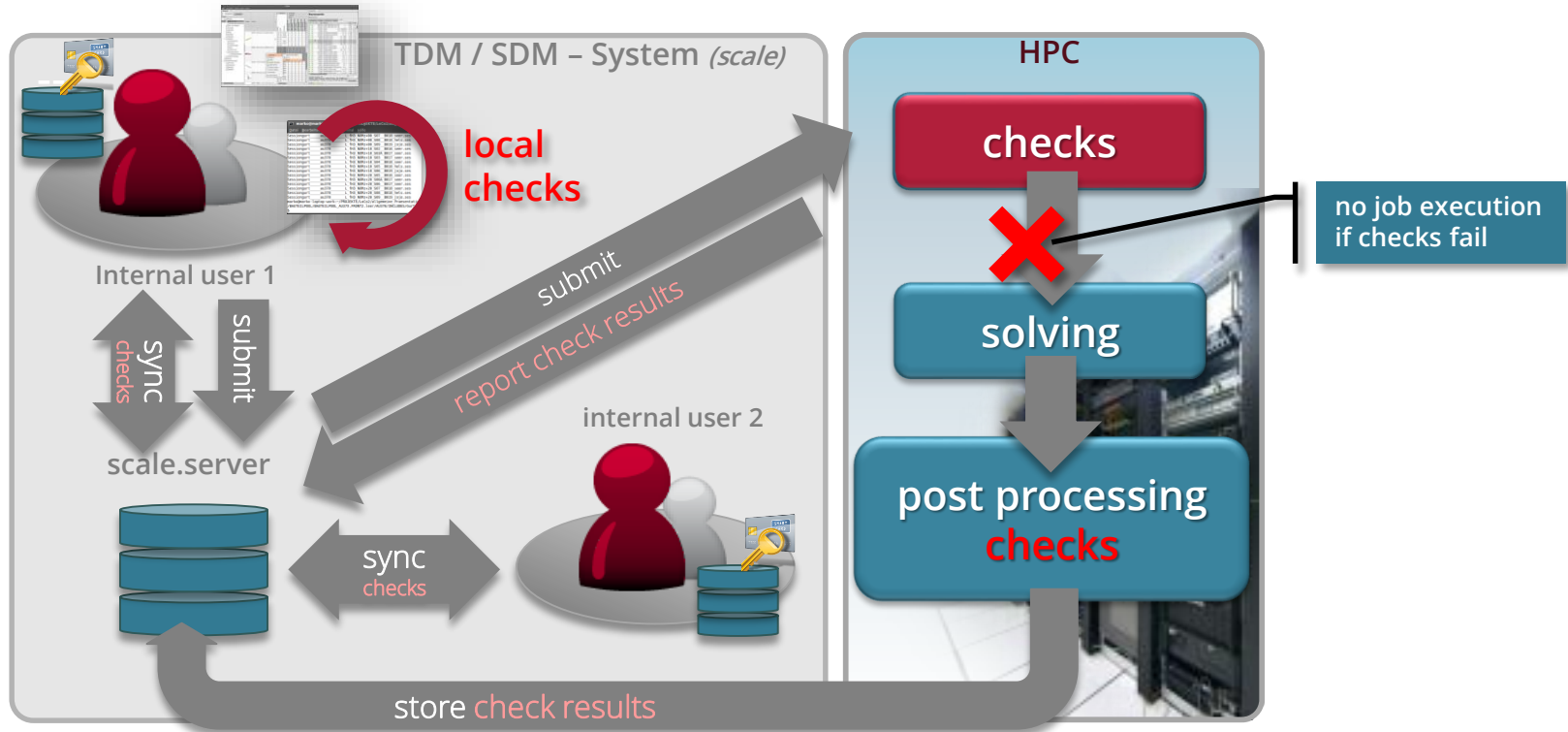
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Recently added: *check infrastructure*



check early
immediate actions

- Checks are carried out as early as possible in the process
- Checks are integrated by using existing tools and scripts
- Checks are enforced at various occasions during the process

check often
prevent errors
save resources

- Each time a file changes
- Before solving
- As part of the post processing
- Checks can stop the process
- Check results are synchronized among all users

Recently added: *check infrastructure*

Check results are propagated

The screenshot displays the LoCo2 (Evaluation) software interface. The main window shows a table of components with columns for Name, Short description, and Image. A red arrow points from the 'Checks' column of this table to the 'Checks' tab in the 'Properties' window for the 'Frontklappe' component. The 'Checks' tab lists various checks with their results (pass/fail/warning) and descriptions. A second red arrow points from a check result in the 'Checks' list to a file explorer window that has opened the file 'Frontklappe' at line 472217. A third red arrow points from the 'Frontklappe' component in the main table to the 'Checks' tab in the 'Properties' window.

Name	Short description	Image
Fahrwerk	HiRa_u_Lenker_hinten	465
Fahrwerk	HiRa_u_Lenker_vorne	465
Fahrwerk	HiRa_vo_LL	717
Frontend Sensoren	Frontend Sensoren	465
Frontscheibe	Frontscheibe	465
Heckklappe	Heckklappe	766
Instrumententafel	Instrumententafel	752
Karosserie	Rohkarosserie	766
Karosserie Mapping	SaeuleA_M01	736

Properties - Frontklappe

Name	Result	Description
Inputchecker	✗	ESI Inputchecker Results
EMNA	✓	Set a default NAME if empty
IEMN	✓	Check in CNTAC if the initial penetration flag is set to 2
CT10	✓	Set in CNTAC type 10 EDGLN to 0.15 if greater
IOMI	✓	Set for CNTAC type 36/46 the IOMIT flag to 1 if switched to 0 (INPU
NIOT	⚠	Move the number of integration points from SHELL card to PART an
PART #1000010	⚠	set the number of integration points from 3 to 5.
PART #1000015	⚠	set the number of integration points from 2 to 5.
PART #1000016	⚠	set the number of integration points from 2 to 5.
PART #1000017	⚠	set the number of integration points from 2 to 5.
PART #1000018	⚠	set the number of integration points from 2 to 5.
PART #1000019	⚠	set the number of integration points from 2 to 5.
PART #1000041	⚠	set the number of integration points from 3 to 5.
PART #1000044	⚠	set the number of integration points from 3 to 5.
PART #1000051	⚠	set the number of integration points from 3 to 5.
PART #1000052	⚠	set the number of integration points from 3 to 5.
PART #1000054	⚠	set the number of integration points from 3 to 5.
PART #1000078	⚠	set the number of integration points from 3 to 5.
PART #1010000	⚠	set the number of integration points from 3 to 5.
PART #1010001	⚠	set the number of integration points from 3 to 5.
PART #1010003	⚠	set the number of integration points from 3 to 5.
PART #1010004	⚠	set the number of integration points from 3 to 5.
PART #1010005	⚠	set the number of integration points from 3 to 5.
ISH3	⚠	Set 3D MATER hourglass prevention flag (ISHG) to 2
MATER #1000000	⚠	set the hourglass prevention (ISHG) from 0 to 1.
SIGC	⚠	Check for MATER types 21, 24 and 45 if the compression curves are
MATER #1000000	⚠	comp. FUNCTION #1000010 the max strain (0.380935) is too small. E
MATER #1000000	⚠	comp. FUNCTION #1000011 the max strain (0.380935) is too small. E
MATER #1000000	⚠	comp. FUNCTION #1000012 the max strain (0.380935) is too small. E
MATER #1000000	⚠	comp. FUNCTION #1000013 the max strain (0.380935) is too small. E
MATER #1000000	⚠	comp. FUNCTION #1000014 the max strain (0.380935) is too small. E
MT45_Q2	✗	Set for MATER type 45 linear bulk viscosity coefficient (Q2) to 6e-05
MATER #1000000	✗	line:472217
Contacts	⚠	View corresponding file: 'Frontklappe' at line:472217

Files can be opened at the line where the error occurred

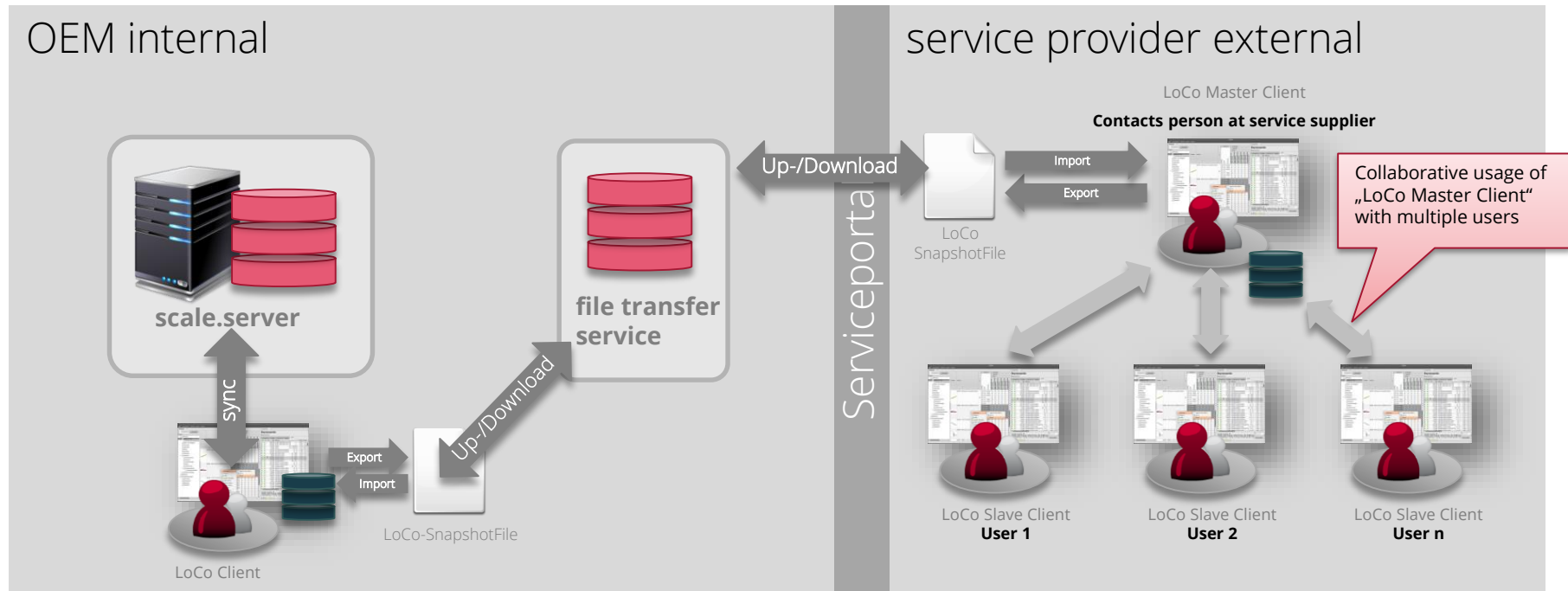
Recently added: *multi run setups*

- Automatic generation of multiple runs
- Permutation through a provided list of experiments
- Integration with LS-OPT
- Usecases
 - Cockpit
 - pedestraint
 - Sensorik
 - ...

The screenshot shows the LoCo2 (Evaluation) software interface. On the left, a project tree displays a hierarchy of components including '323 [Testversion für Multipoint]', '325 (current, private) [test]', 'Airbag', 'Dokumentation', 'Kopfaufschlag', and 'Fahrzeug'. The 'Fahrzeug' component is expanded to show sub-components like 'Cockpit', 'Identifizier', and 'Impaktort Transformation'. On the right, a table displays a list of generated runs. The table has columns for 'Row', 'CockpitIdentifizier', 'Schussnummer', 'CockpitLastfallbezeichner', 'Z-Movement', and 'Type'. The table contains 6 rows of data, each representing a generated run. A red box highlights the 4th row, which is 'HEAD', '0004', 'disp_5_80', '212.33', and 'FR'. A callout box points to the table with the text 'list of experiments'. Another callout box points to the highlighted row with the text 'One generated run per line in the list'.

Row	CockpitIdentifizier	Schussnummer	CockpitLastfallbezeichner	Z-Movement	Type
1	HEAD	0001	disp_5_80	297.65	FR
2	HEAD	0002	disp_5_80	288.51	FR
3	HEAD	0003	disp_5_80	279.44	FR
4	HEAD	0004	disp_5_80	212.33	FR
5	HEAD	0005	disp_5_80	226.41	FR
6	HEAD	0006	disp_5_80	196.47	FR

Recently added: *complete offline usage*



- Fast integration for new service suppliers
- Minimizing on site resources
 - Less traffic
 - Less user accounts
 - Less server load
- Use existing file transfer mechanisms
- Bridge technology to get started while planning a tight integration

Recently added: *multi stage assemblies*

Bag folding

- Bag geometry
- Housing
- Tools
- Parameters



Folded air bag

Dummy, Seat, Belt positioning

- Dummy
- Seat
- Belt
- Parameters



Positioned, Seated and belted Dummy

Cockpit assembly

- Cockpit parts
- ...
- ...



Assembled cockpit

Mapping processes

- Parts
- Tools
- Mapping parameters



Mapping data

...

- Barriers
- Materials
- ...

...

car assembly



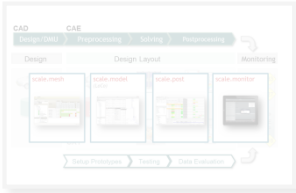
Assembled car model

car 2 car assembly



Assembled car 2 car crash model

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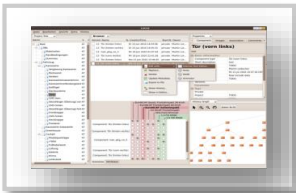
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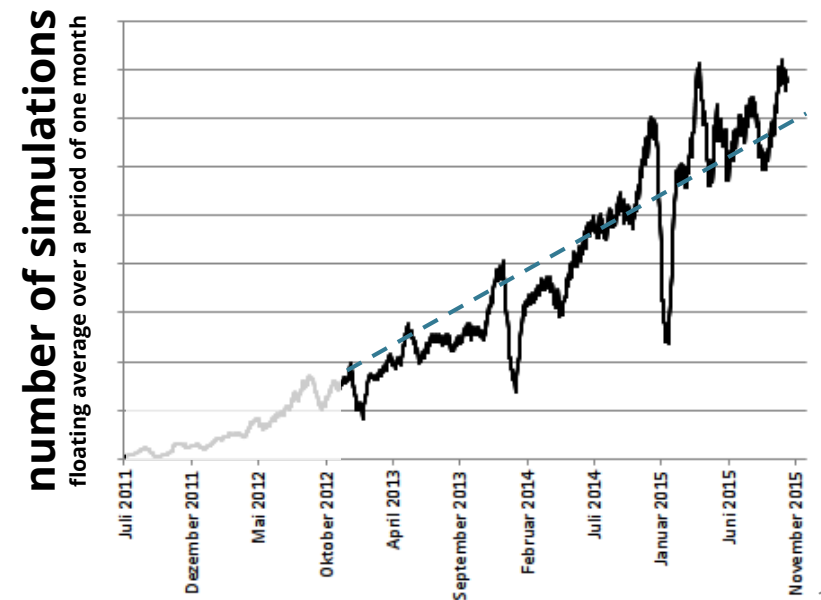
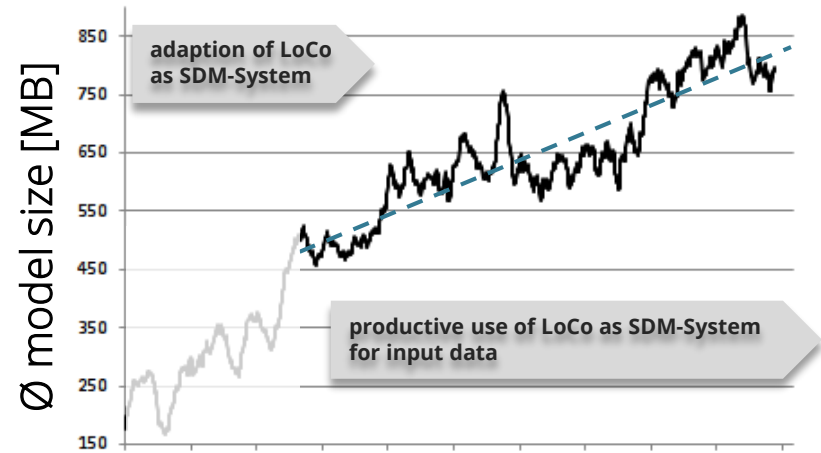


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In development: *compression*

- Increasing average model sizes
 - average model size is still increasing
 - input data today partly exceed 1GB
- Increasing number of simulations
 - more load cases
 - more vehicle models
 - more simulation disciplines
 - more ...
- Increasing throughput of simulations per user
 - Individual users are doing more simulations



In development: *INPUT Data*

- File level Data Deduplication
 - each Simulation consists of multiple Files
 - changes for a simulation usually only affect a few files
 - only changed files are stored and transferred
 - savings approximately factor ~30
 - **standard in LoCo**
- Block level Data Deduplication
 - changes on simulation input usually affect only a few lines
 - file is separated into blocks
 - only changed blocks are stored and transferred
 - savings approximately factor ~4
 - **in development for LoCo** (VAVID)¹
- Standard compression algorithms
 - simulation input files are usually ASCII
 - standard compression algorithms (e.g. zip, bzip, lzma) work best on ASCII data
 - savings approximately factor ~3
 - **standard in LoCo**

500TB raw input data

16TB unique files



4TB unique blocks

1 TB stored data

In development: *OUTPUT data*

■ Test Data

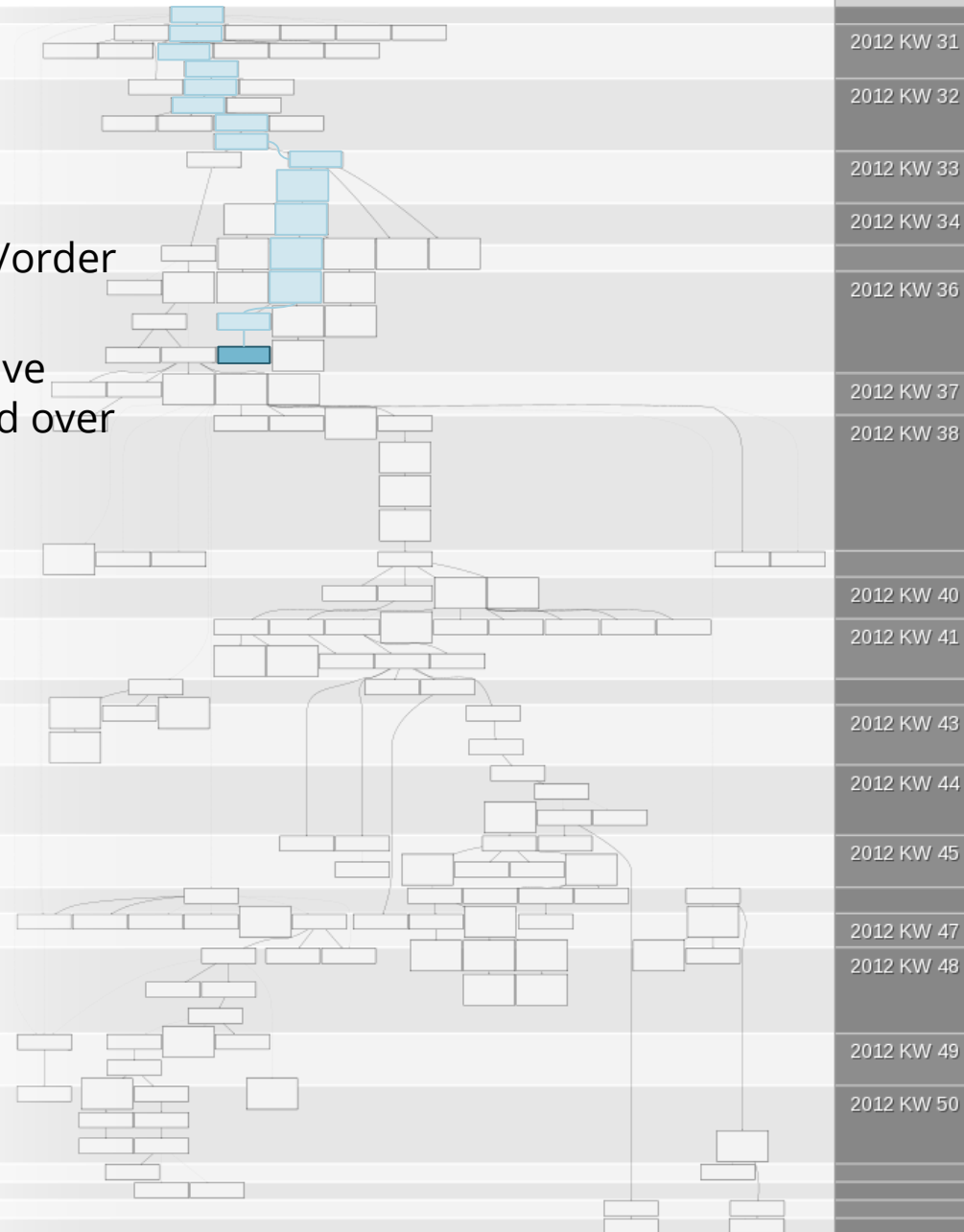
- one load case (*front wall*)
- 155 Results
- compressed with respect to history/order of creation
- Results are extracted from productive environment and have been created over a period of approximately 6 month

■ Results

FEMZIP-P		13,95 GB	
FEMZIP-E	FDB	0,85 GB	15%
	EFZ	5,00 GB	85%
	Total	5,85 GB	
FEMZIP-E + gzip		4,74 GB	

Factor P/E **2,94***

* higher compression rates of up to factor 4 could be achieved when compressing all files at once



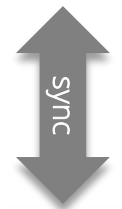
In development: *CAD/Meshing Integration*

- **CadMe:** plugin for LoCo to support meshing and other processes
- Import CAD-Part structures and geometry from PDM-Systems
- Integrate meshing tools (e.g. ANSA)
- Do collaborative work with multiple colleagues and see how far they got

The screenshot displays the CadMe application window. On the left, a tree view shows the CAD model structure under 'STRUKTUR' and 'ZSB Karosserie'. The central area is a table with columns for 'Attributes' (Antriebsart, Lenkerserie, Region, Symmetry) and 'Process' (Import, ANSA meta data, Symmetry, Solids, Mid Surface, PID). The table rows list various car parts like 'Dach', 'Heckabschlussstiel', and 'Verstärkungsrahmen'. The right panel, titled 'Process executor', shows a list of processes with checkboxes and 'run on selected' buttons. Below it, a 'Job status' window shows 'Executing: Data preparation / ANSA meta data'.



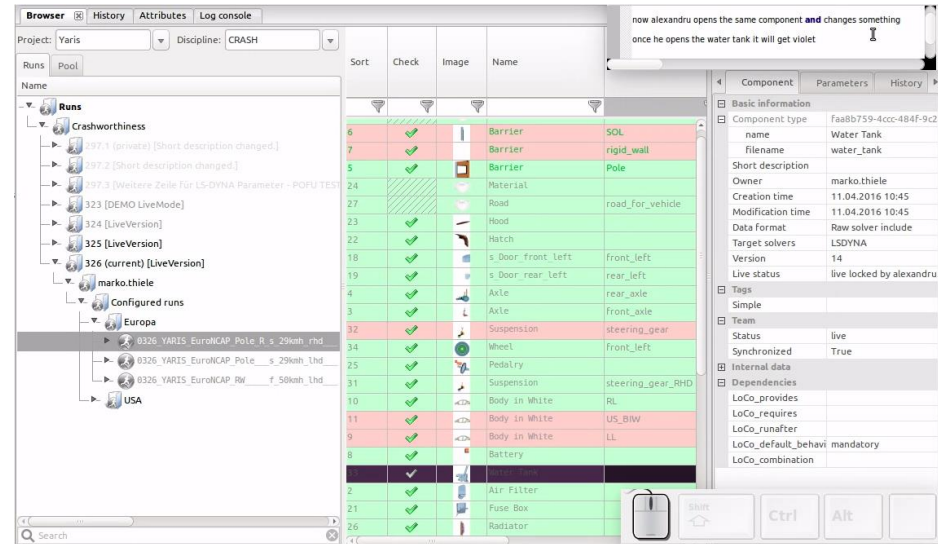
LoCo-TDM
Server



LoCo Client
(with CadMe Plugin)

In development: *Live Mode*

- UseCase: Initial Model Setup
- Live PoolVersions can be accessed by multiple users simultaneously
- Locking is managed by LoCo
 - Objects can only be modified by one user at a time
 - Objects are locked automatically when files are opened
 - Locked objects are immediately reiconicable
 - Project managers can remove locks at any time
 - Assemblies are always possible
- Users have to be „online“ and connected to the server in order to use the LiveMode



In development: *Live Mode*

The screenshot displays the SCALE software interface in a development environment. The top navigation bar includes 'Browser', 'History', 'Attributes', and 'Log console'. Below this, the 'Project' is set to 'Yaris' and the 'Discipline' is 'CRASH'. The 'Runs' panel on the left shows a tree structure under 'Runs' > 'Crashworthiness', with the current run '323 (current) [DEMO LiveMode]' selected. The central workspace shows a table with columns 'Image', 'Attributes', and 'Short owner', containing one entry for 'marko.thiele'. The right-hand panel displays 'Basic information' and 'Enforced attributes' for the selected run.

Image	Attributes	Short owner
		marko.thiele

Basic information	
Group name	Yaris
Owner	marko.thiele
Version	323
Live status	
Creation time	11.04.2016 10:01
Modification time	11.04.2016 10:03
UUID	e74849bb-8257-4402-9

Enforced attributes	
Tags	
Simple	
Team	
Status	public
Synchronized	True

At the bottom of the interface, there is a status bar with 'Synchronizing pool...', 'Offline Mode' (unchecked), and 'Disable Popups' (unchecked). A mouse cursor is visible over the interface.

Roadmap



Web Client

convenient access to data, particularly for monitoring



Integration with Collaboration and Ticket Systems

Jira, Open Project, ... for SDM related task management



UI Redesign of SDM-Client

more intuitive, more efficient, more modern appeal

Vielen Dank!

SCALE 

The screenshot displays the LoCoX application window. The main interface is divided into several sections:

- Project Tree (Left):** A hierarchical view of the project structure. The 'Cockpit' folder is currently selected.
- Table (Center):** A table listing components with columns for Name, Pool-Version, Änderungsdatum, and Eigentümer. The 'Modulquerträger' component is highlighted.
- Properties Panel (Right):** A panel titled 'Eigenschaften' showing details for the selected 'Modulquerträger' component.
- Information Dialog (Bottom Center):** A small dialog box titled 'Informationen' with tabs for 'Ennius', 'Sapines', and 'Lorem ipsum'. It contains placeholder text and a horizontal bar chart.

Name	Pool-Version	Änderungsdatum	Eigentümer
Fahrerseite	13	18.09.13 - 10:21	otto
geschlossen kin	13	18.09.14 - 20:21	otto
Bild	13	08.09.13 - 18:38	vuvg65u
plus 3kg	13	19.09.13 - 22:45	torsten
Modulquerträger	2	18.09.13 - 10:21	torsten
versagen	16	18.10.15 - 20:47	otto
Klimagerät	16	18.09.13 - 20:21	vuvg65u
Lenksäulenver...	2	14.11.11 - 11:17	vuvg65u
geschlossen	2	18.09.13 - 20:21	torsten
offen kin	2	18.09.14 - 20:21	otto
Instrumente	2	08.09.13 - 18:38	otto
geschlossen	2	19.09.13 - 22:45	vuvg65u
offen	2	18.10.15 - 20:47	torsten
Impaktor Tra...	2	18.09.13 - 20:21	otto
Identifiz...	1	14.11.11 - 11:17	vuvg65u

Eigenschaften: Modulquerträger

- Version: 2
- Pool-Version: 2
- Erstelldatum: 31.08.11 ...
- Änderungsdatum: 18.09.13 ...
- Eigentümer: torsten
- Komponententyp: Modulquer...

Informationen: Lorem ipsum

Il molorer uptatecus nam ipicillis repreiur sum que nam fugitatur ommolor ehenimagnime nim rem que est parum

Il molorer

uptatecus

nam ipicillis