

# SCALE

IT-Solutions for CAE



# SCALE.sdm

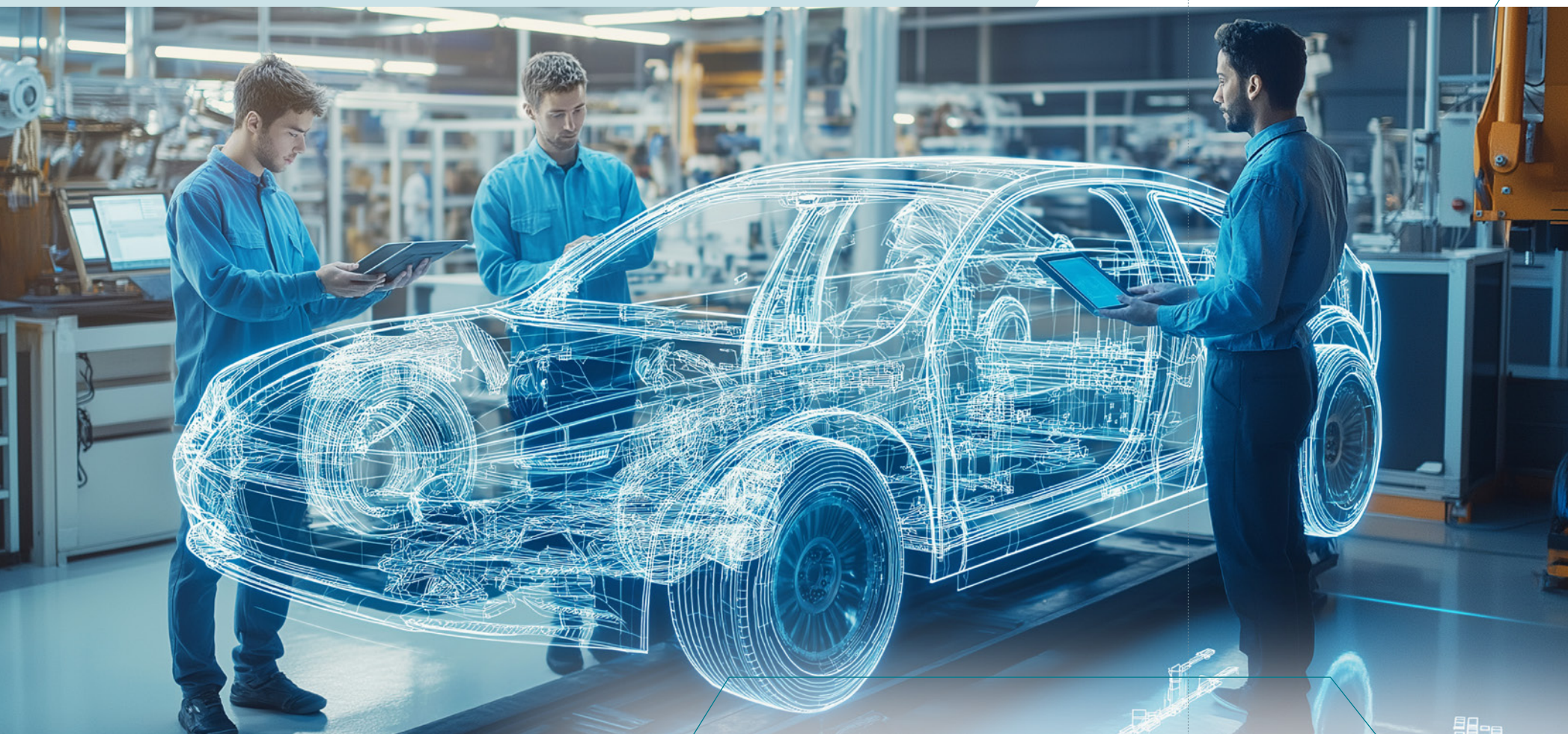
Master **Complexity**  
Drive **Innovation**



**SCALE.sdm:**  
**Simulation Data and Process Management**

# THE FUTURE OF ENGINEERING

In the world of virtual product development, managing large volumes of data and complex workflows is a significant challenge and can be overwhelming. SCALE.sdm is designed to empower teams by providing tools that ensure efficiency, scalability, and clarity at every stage of the process – keeping the focus where it matters most.



## Why SCALE.sdm?



### Lifecycle Management of Data and Processes

Streamline every stage of product development, from managing simulation and test data to driving workflows, milestone approvals, and project monitoring, ensuring efficient data management and faster time to market.



### Efficient Collaboration

Centralize simulation and test data in one place, enabling seamless sharing across teams and partners while eliminating data fragmentation and inefficiencies.



### Smarter Decisions

Turn simulation and test data into actionable insights with integrated analysis and standardized reports, leading to faster, data-driven decisions.



### AI and ML Integration

Easily integrate AI and Machine Learning tools to accelerate development.



### Streamlined Project Management

Implement systems engineering in your projects with comprehensive monitoring functions that ensure transparency and traceability at all levels.



### Flexible, Open Platform

Seamlessly integrate your systems and tools with SCALE.sdm. Comprehensive customization options make it fit your needs.



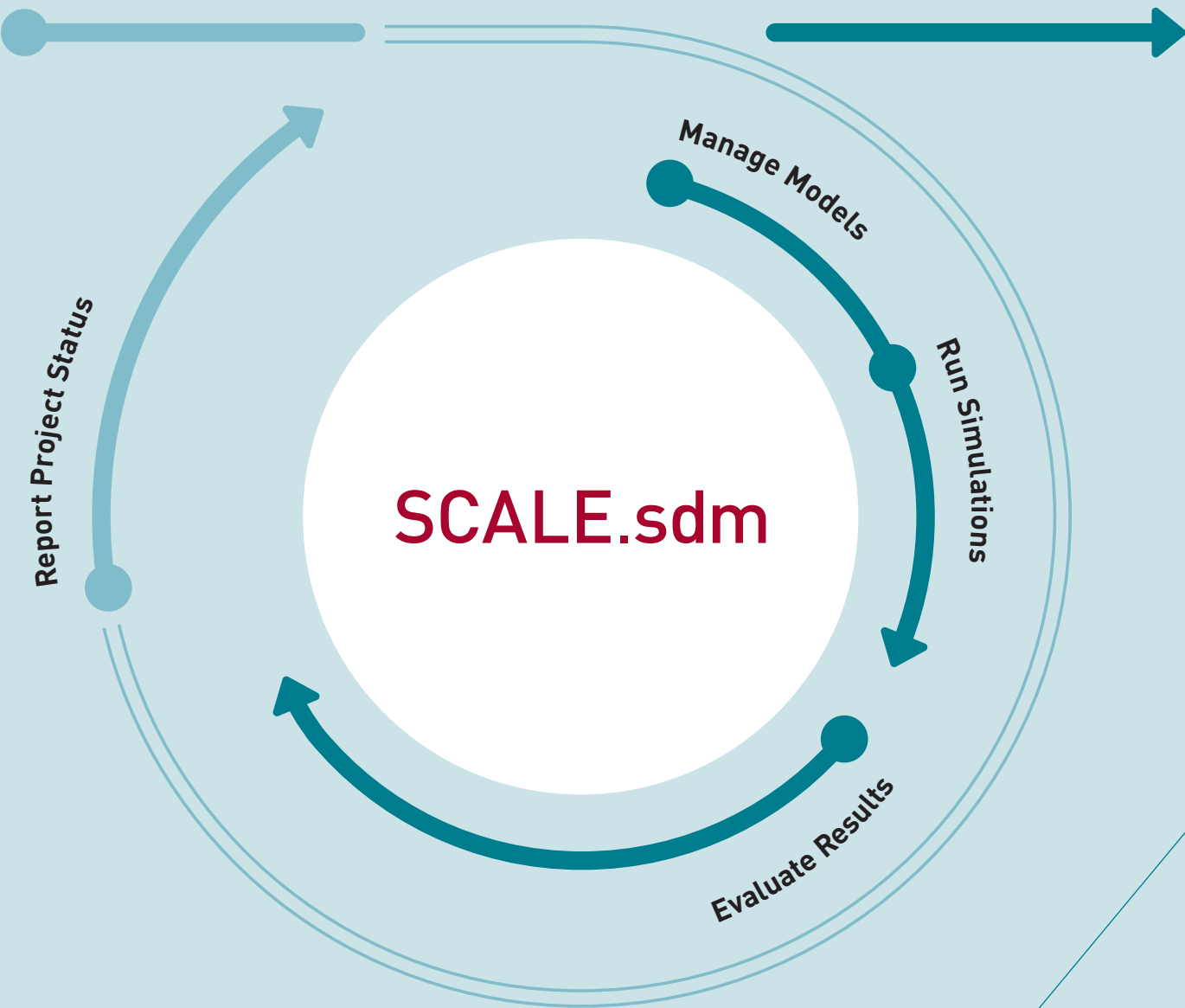
# Elevating the Product Development Cycle

## FROM DIGITAL PROTOTYPES TO PRODUCTION READINESS

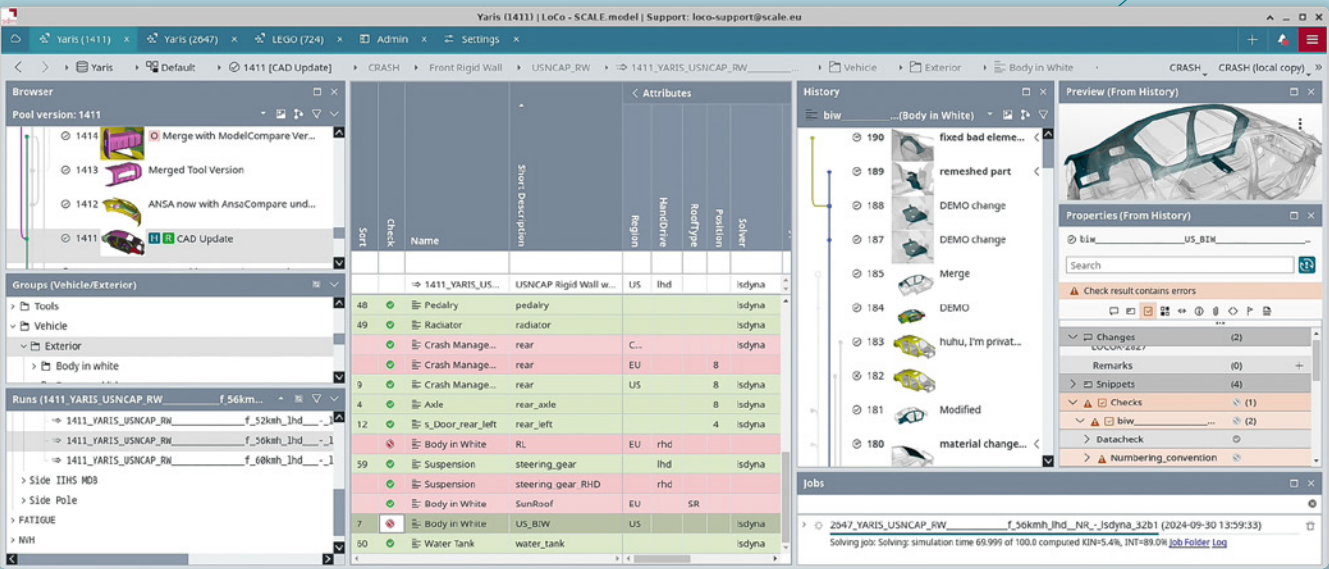
SCALE.sdm supports the entire virtual product development process – from creating digital prototypes to simulation, validation, and final approval for production. From project setup to production readiness, SCALE.sdm enables smooth management of all simulation data and processes, giving you full control while speeding up your development towards market-ready products.

SETUP PROJECT

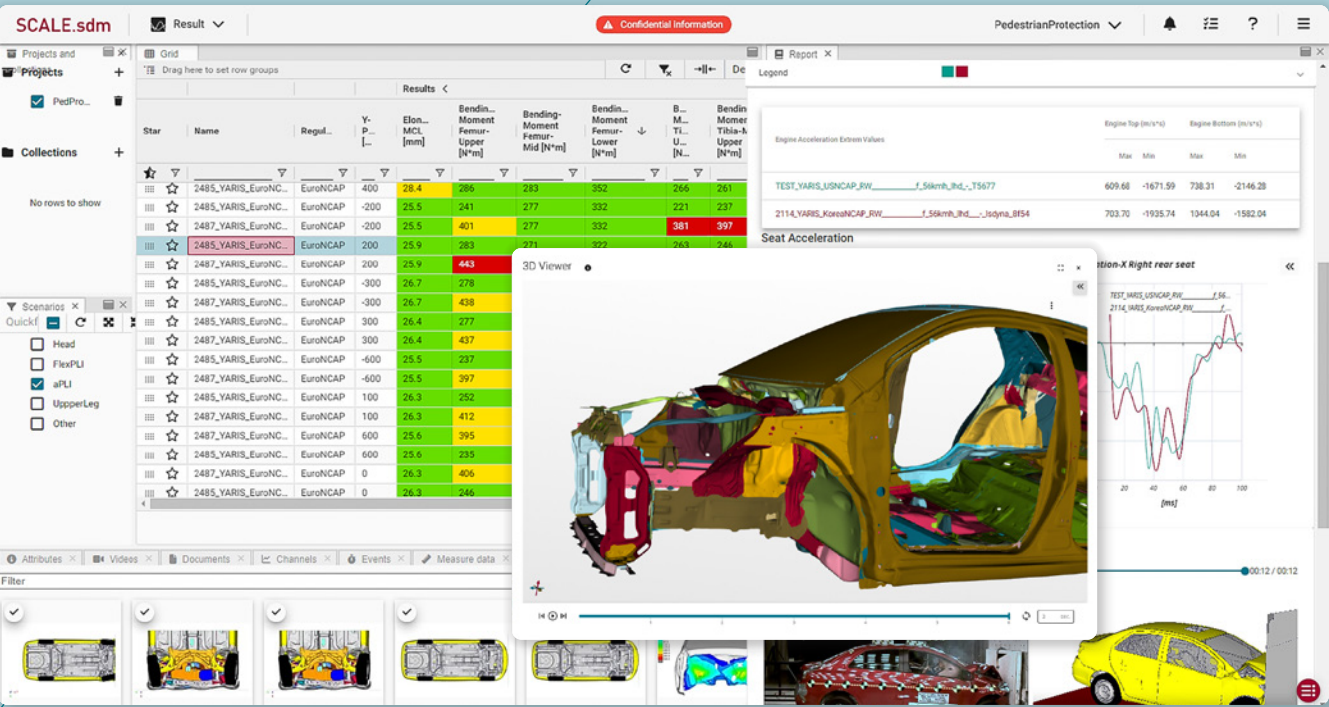
START OF PRODUCTION



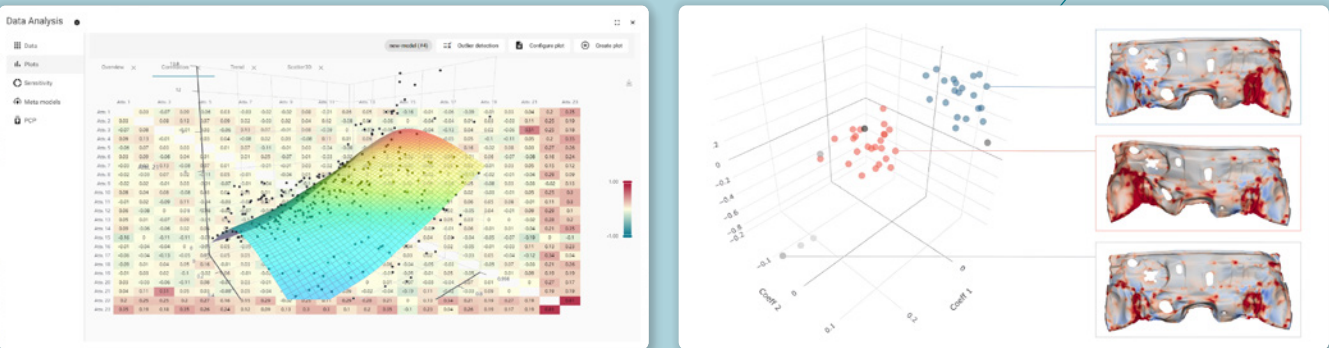
## Manage Models and Run Simulations



## Evaluate Results



## Data Analysis and AI Integration





## Collaboration

# MANAGE SIMULATION AND TEST DATA EFFECTIVELY

In today's highly connected, digital, and global environment, collaboration occurs both across an organization's teams and departments, and with external partners. Companies need a robust platform to unify all stakeholders, ensure efficient and transparent data access, and protect their knowledge. Such a system should also minimize the time spent searching for data and provide dashboards, monitoring, and oversight of the development process to effectively manage projects.

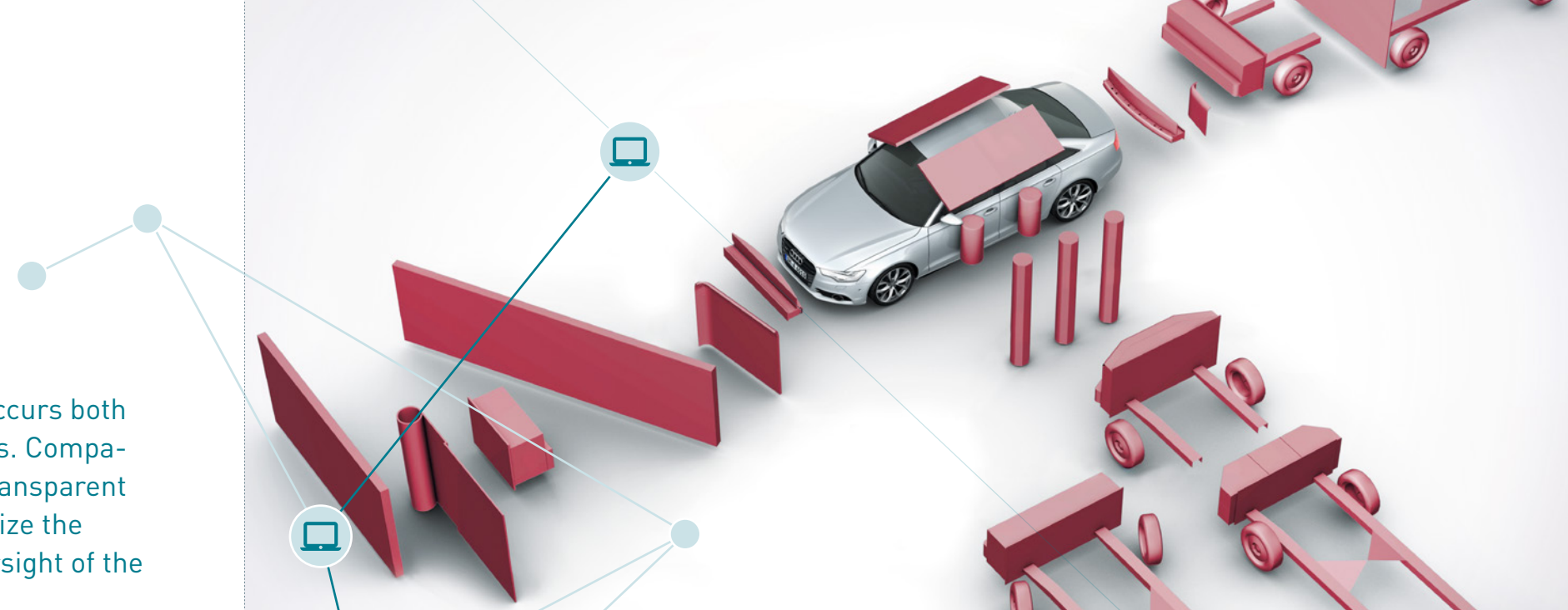
With SCALE.sdm, we can efficiently manage the wide variety of our vehicle models and load cases, and significantly improve collaboration with service providers, suppliers, and between the brands of the VW Group.

Richard Luijckx, AUDI AG



## One Place for All Data

Having a central, unified place for simulation and testing data – both models and results – streamlines data exchange within teams. It simplifies the sharing of essential model components, making them easily accessible and usable across all projects. The system provides searchable and organized access to all models and results while ensuring that large data volumes are securely archived. Users can access their data via a browser or local tools, improving the efficiency of data management and retrieval.



## Manage the Complexity

With a multitude of market-specific load cases and an expanding number of product configurations, the number of simulations continues to grow. SCALE.sdm offers a comprehensive suite of tools to efficiently manage these many different simulation variants, automating and clearly organizing simulations across all load cases.



Collaborating with CAE-Processes and -data across several Brands of the VW-Group, NAFEMS DACH Conference 2024

## SUCCESS STORY

### Driving Efficient Collaboration with SCALE.sdm

#### The Client's Challenge

Previously, simulation teams worked independently, using different methods to store and manage their files. This lack of consistency made it difficult to share and integrate models, even for common components such as materials or barriers.

#### Actions

SCALE.sdm was introduced to standardize and unify simulation models across departments and brands. Despite initial adaptation challenges, it established a shared framework that improved collaboration.

#### Results

With centralized data access, teams can now start projects quickly using shared data pools. New simulation disciplines are easily integrated, leading to streamlined, automated project execution.

Customer: AUDI AG – Industry: Automotive





## Automate Workflows and Boost Your Productivity

Automate essential workflows to enhance efficiency and reduce errors. This approach improves quality and saves time, allowing you to focus on core tasks without needing specialized expertise. Automation facilitates easy setup, submission, and analysis of simulations by any user, while customizable quality checks ensure consistent standards.

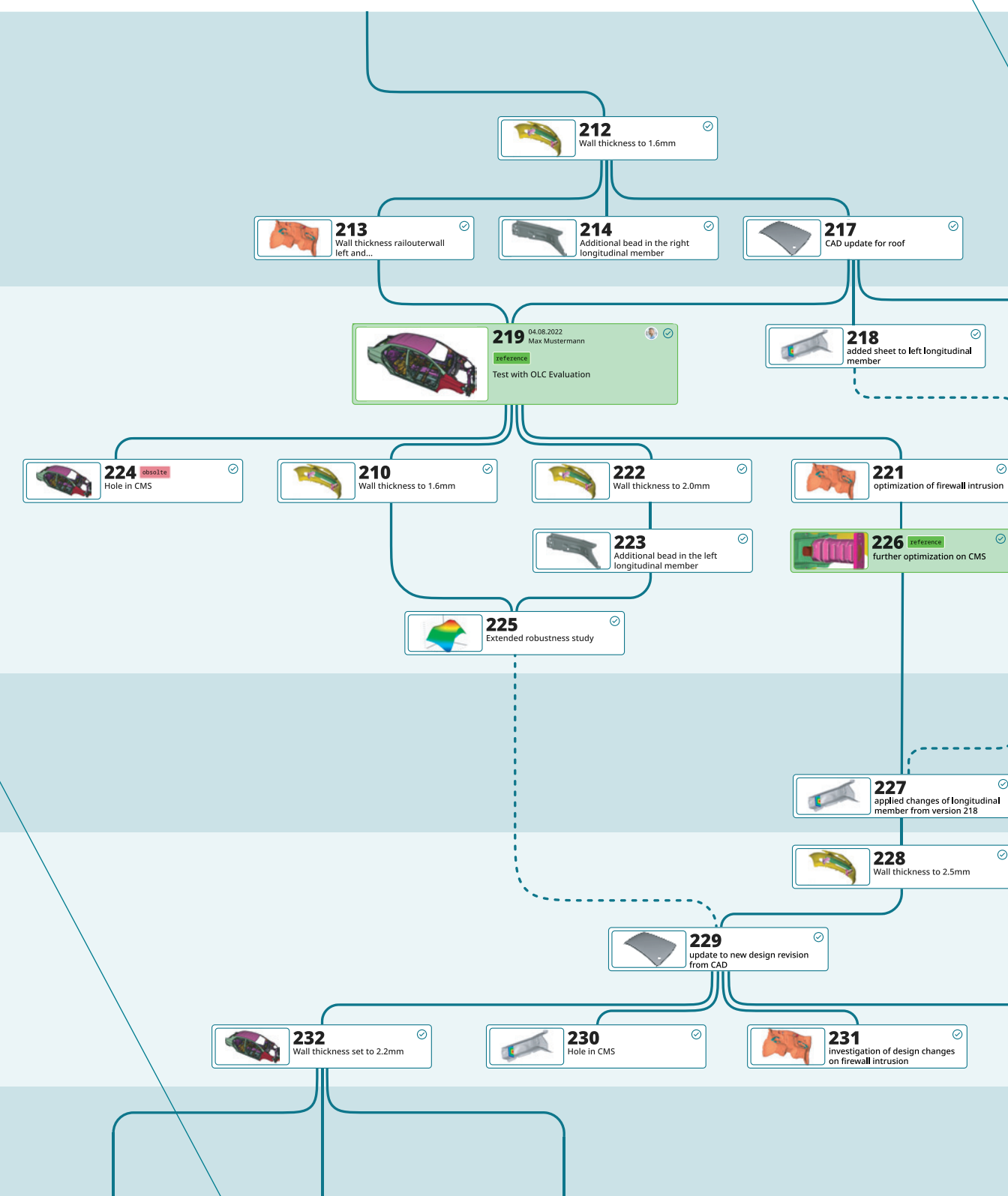


## Transparent and Well-Documented

All data changes are meticulously recorded and accessible to the entire team, ensuring a clear historical record of modifications. This thorough documentation enhances collaboration and helps prevent data-related misunderstandings.

### Keep Track of All Changes

Track every change to simulation models with detailed version histories, including user information and preview images. See who made changes, when, and how data elements are connected. Visualize data evolution clearly to enhance understanding and collaboration.





# Analysis and Reporting

## UNCOVER INSIGHTS FOR SMARTER DECISIONS

In today's fast-paced world, making data-driven decisions quickly and accurately is essential. Integrate and visualize data from various simulations and physical tests with standardized, predefined reports, ensuring efficient and reproducible evaluations. This approach guarantees that decisions are based on clear, reliable information, moving beyond vague assumptions. Advanced data analysis enhances predictions and informs actions, while robust compliance monitoring ensures adherence to regulations.

» We successfully use SCALE.sdm in the field of vehicle safety for modeling and monitoring project requirements. SCALE.sdm allows us to traceably map test and simulation results, as well as requirements, in one system and apply them for detailed comparative analyses.

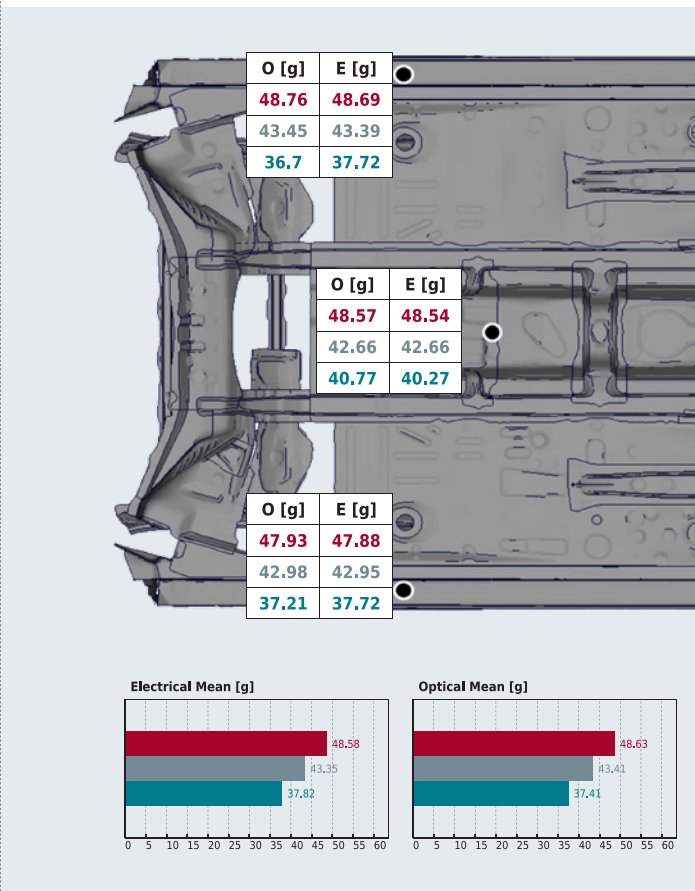
Marcel van den Hove, AUDI AG

### Compare Simulation and Testing Insights

Easily access and analyze simulation and testing data with automated reports. Compare results from simulations and physical tests to gain valuable insights. View and evaluate outcomes swiftly through your preferred interface, whether on your desktop or online, ensuring alignment with project goals and target metrics.

### Visually Explore Your Data

Interact with your data through 3D visualizations and advanced plots. Use multi-axis diagrams for detailed analysis and perform data operations such as filtering and trimming. Preview 3D models in your browser and conduct in-depth analyses with post-processors.



### SUCCESS STORY

## Central Solution for Data Management

#### The Client's Challenge

Efficient management and analysis of simulation data were hampered by disjointed systems and fragmented processes, leading to inefficiencies and delays.

#### Actions

SCALE.sdm was implemented as the central solution, integrating simulation data management and analysis into one unified platform.

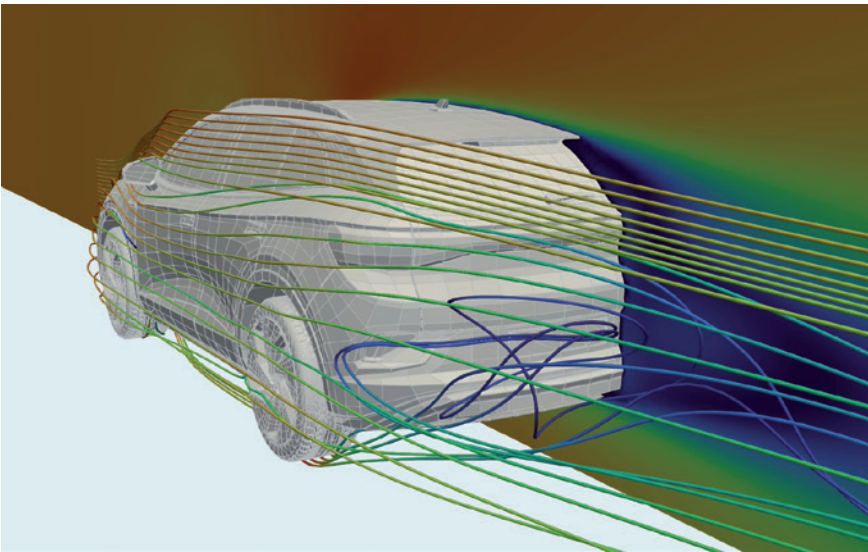
#### Results

The system has significantly improved efficiency and collaboration by centralizing data management and streamlining analysis, delivering tangible benefits in the client's operations.

Customer: AUDI AG – Industry: Automotive

### Unlock Extensive Reporting Capabilities

Customizable and interactive reports support detailed analyses and informed decision-making. Address complex needs in specialized areas such as Computational Fluid Dynamics (CFD) and Noise, Vibration, and Harshness (NVH). Comprehensive textual reports provide a thorough understanding of your data, leading to more accurate insights and actionable outcomes.





# AI and ML Integration

## ACCELERATE DEVELOPMENT

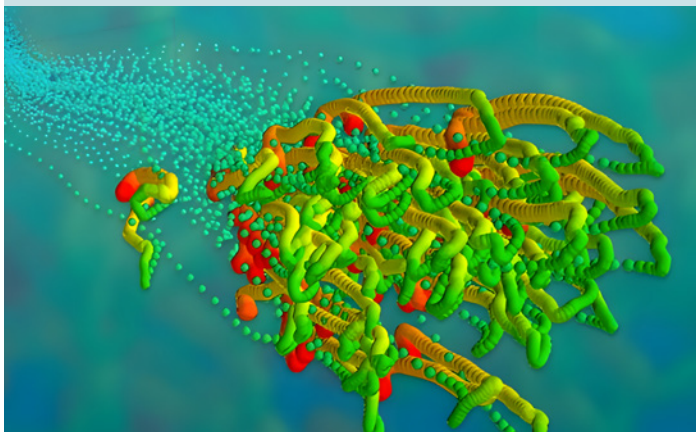
Integrating Artificial Intelligence (AI) and Machine Learning (ML) into your workflows can be challenging due to the domain-specific and proprietary nature of many analyses. SCALE.sdm simplifies this by providing a platform that supports easy integration of ML and AI add-ons. Utilize advanced data analysis to evaluate experimental designs, perform cause-and-effect analyses, and make accurate predictions. Our solution facilitates these processes, reducing development time and enhancing precision.

### Data Analysis for Deeper Insights

Maximize insights from your post data with precise analysis. Automatically identify patterns and predict component behavior. Leverage machine learning algorithms to effortlessly detect events, anomalies, and irregularities in your virtual product development process.

#### INTEGRATION EXAMPLES

The following examples illustrate how AI/ML can be integrated into SCALE.sdm with add-ons. Each add-on has its own independent user interface and server component. The add-ons can also define any additional resources required for execution.



**SimExplore** leverages advanced Machine Learning algorithms to detect patterns and anomalies with precision. This not only saves time but also improves the accuracy in identifying key insights. It allows users to seamlessly analyze design alternatives, facilitating better decision-making and more efficient optimization, ultimately enhancing performance in complex simulations.

SimExplore is a product of Fraunhofer Institute for Algorithms and Scientific Computing SCAI



**FEMALYST** is a CAE tool that automates the detection of unknown and unwanted behavior before engineers even open the results in a post-processor. With FEMALYST it is possible to search for deformation patterns, as well as new failure and postvalue behavior within complete development trees, containing TeraBytes of simulation results in just a few seconds.

FEMALYST is a product of SIDACT GmbH

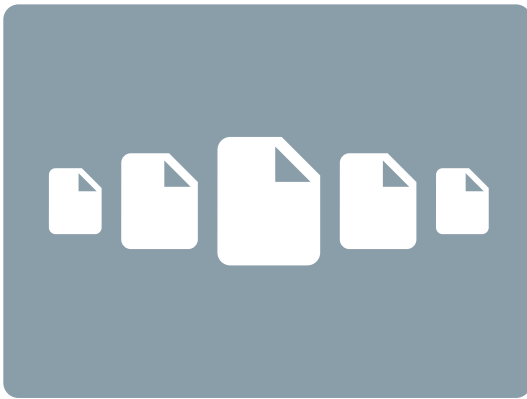


As an applied research institution, we place great importance on early, practice-oriented feedback on our simulation analysis developments based on real customer data. With SCALE.sdm as a platform at the customer's site, we are very successful in doing this for our products SimCompare and SimExplore.

Prof. Dr. J. Garcke, Fraunhofer Institute for Algorithms and Scientific Computing SCAI

### SCALE.sdm

#### CENTRALIZED DATA

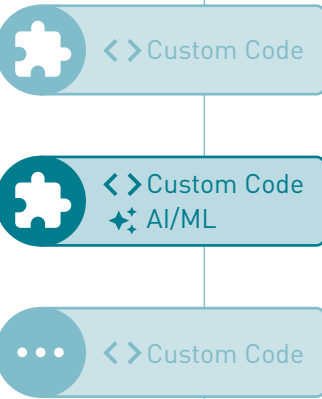


Extend Frontend and Backend

Access

Visualization and Evaluation

#### ADD-ONS



### Integrate Your AI and ML Solutions

Enhance your SDM system by integrating your custom or third-party AI and ML solutions as add-ons. As a cloud native solution, SCALE.sdm allocates resources efficiently and provides comprehensive APIs for full access to your SDM data.



# Systems Engineering

## STREAMLINE YOUR PROJECT MANAGEMENT

Managing complex systems with multiple stakeholders is challenging. Projects need a holistic approach, clear goals, and precise, real-time progress tracking. SCALE.sdm provides a framework for transparent and reliable documentation throughout the product development lifecycle, ensuring consistency, accountability, and alignment at every stage.

➤➤ **ZF LIFETEC is planning the productive rollout of an end-to-end systems engineering process over the coming years. We see high potential in the SCALE software solution for the global provision of data and evaluation processes.**

Arne Wolf, ZF LIFETEC

### Ensure Precision and Clarity in Your Requirements

Clearly define sub-projects and manage load cases with precision. Systematically represent stakeholder requirements and link them to clear technical targets. SCALE.sdm makes reporting current values for targets, based on simulation or testing results, seamless and traceable for all team members.



Requirement	Status	Value	Assessment	Comment	User
Frontal_FMVSS_208_56km/h_starr_0°_100%_LL_1H3	✓				
Chest Acc-3ms-cum		50.003 G	Acceptable		jdoe
Chest Deflection -		-50.1 mm	Good		jdoe
Containment			Not available		
Femur Force le Z-			Not available		
Femur Force ri Z-		-444 kN	Poor	Wrong sensor...	asmith
Head HIC 15ms		501	Good		asmith
Neck Force Z-		-3.1 kN	Good		jdoe
Neck Force Z+			Not available		
Neck Nij NCE		0.8	Acceptable	Better next ti...	jdoe
Neck Nij NCF		0.79	Good		asmith
Neck Nij NTE			Not available		
Neck Nij NTF			Not available		
1.0.00.R.O.FIREWALL_ZONE_M1_MAX_DISPLACEMENT_X	✓				
Frontal_FMVSS_208_LL_Wand26_0m_1H3p_3HFp	✗				
Frontal	✓				
Frontal	✗				
Frontal	✓				
1.0.00.F	✓				
Frontal	✗				
Frontal	✓				
Frontal_FMVSS_208_56km/h_starr_0°_100%_LL_3H3	✓				
Frontal_FMVSS_208_LL_Wand40_0m_1H3p_3HFp	✓				
1.0.00.R.O.FIREWALL_ZONE_M1_MAX_DISPLACEMENT_X	✓				
Frontal_FMVSS_208_LL_Wand26_0m_1H3p_3HFp	✗				
Frontal_FMVSS_208_56km/h_starr_0°_100%_LL_Fahrzeug_schwer_H3	✓				

**Thresholds Femur Force ri Z-**

$-\infty \leq x < -10.009 \text{ kN}$	$-10.009 \text{ kN} \leq x < -8.007 \text{ kN}$	$-8.007 \text{ kN} \leq x < \infty$
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### Stay on Top of Every Detail

Set project milestones, define load cases, and assign responsibilities. Simulation and testing results are automatically matched to targets, keeping the status up-to-date for accurate tracking. Comprehensive monitoring ensures transparency and traceability, allowing you to easily spot delays or unmet requirements.

#### Virtual Testing

Rating agencies and regulations increasingly allow virtual testing, where simulations replace physical tests. SCALE.sdm provides all the tools needed to set up virtual testing efficiently and in compliance, from model creation to evaluation. Ensure that all required, validated components are securely utilized in your simulations.



### SUCCESS STORY

## SCALE.sdm as a Central Hub for Systems Engineering

#### The Client's Challenge

Managing product requirements, milestones and system integration was fragmented across various services, affecting continuity and development efficiency.

#### Actions

SCALE.sdm was implemented as central data hub, interacting with third party data sources of product development parameters and unifying the requirements management and milestones into a single platform, which is accessible at all ZF LIFETEC locations.

#### Results

The solution is poised to significantly enhance efficiency and global collaboration by centralizing product data and requirements management and tracking, offering strong potential for optimizing systems engineering processes.

Customer: ZF LIFETEC – Industry: Automotive Supplier



## Open Platform

# ACHIEVE SEAMLESS INTEGRATION AND CUSTOMIZATION

In a world where processes are unique and IT landscapes are complex, flexibility and integration are the key. Our platform offers a highly customizable solution, allowing for easy expansion and development by third parties. With open interfaces and support for current technologies, we ensure smooth connectivity with existing systems and processes.

### ✓ Tailor Solutions Specifically to Your Needs

Tailor your platform with customizable features and workflows, supported by open, well-documented interfaces. Easily expand both frontend and backend with add-ons to suit your evolving needs.

### ✓ Integrate CAE and In-House Tools Effortlessly

Easily integrate pre- and post-processors, as well as any CAE and in-house tools, for seamless collaboration across your entire individual workflow.

### ✓ Open APIs Allow Integration with Ease

Our versatile API access enables smooth integration and customization, empowering you to extend your platform as your business grows.



**The SCALE.sdm API provides us with flexible, high-performance access to our data and its meta information within SCALE.sdm. This interface enables us to break new ground in data analysis, ensure data consistency, and enhance process automation.**

*Simulation Specialist, Vehicle Safety – German Automotive OEM*

## SUCCESS STORY

### Optimized Data Access through SCALE.sdm API

#### The Client's Challenge

Consistently managing simulation data across multiple systems, including SCALE.sdm.

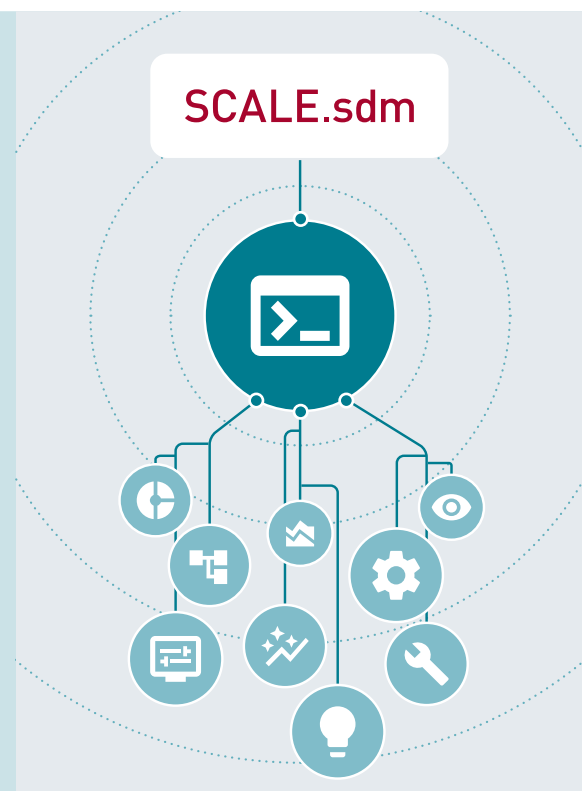
#### Actions

An automated process was integrated into the existing environment to query data and meta-information from the open platform SCALE.sdm using its API.

#### Results

The result was an efficient and fully integrated process that uses the SCALE.sdm API to ensure data integrity across systems and drive process automation.

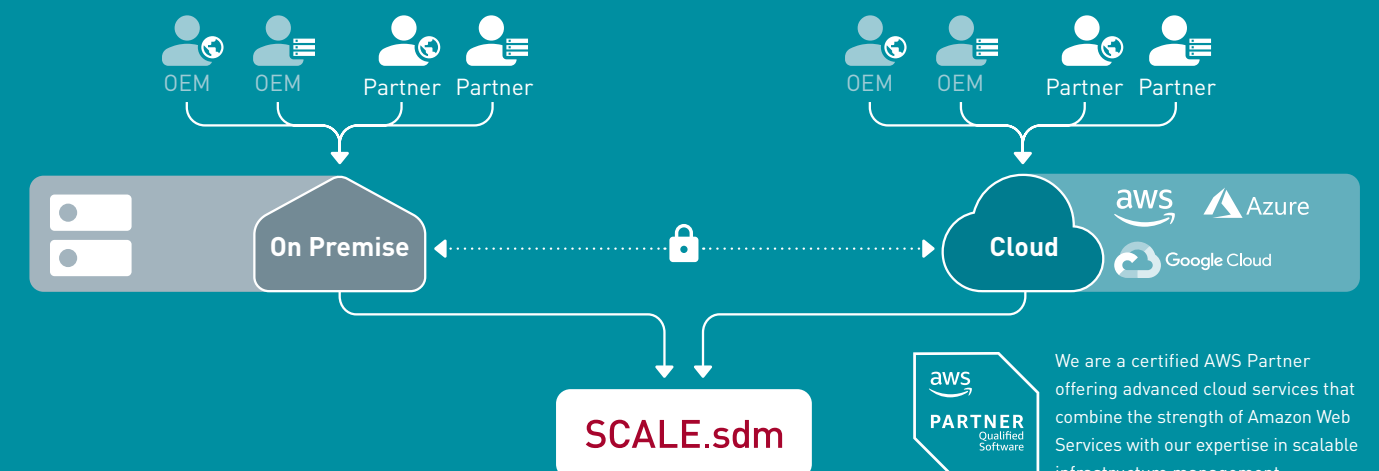
**Industry:** German Automotive Industry



## OPERATION

### Deploy Solutions with Flexibility

Our cloud-native platform offers scalable solutions, deployable on-premises or with cloud providers like AWS, Azure, or Google. Infrastructure as Code (IaC) streamlines setup and management, ensuring faster deployment and consistent environments. Comprehensive monitoring is included, and Software as a Service (SaaS) options are available for added flexibility.



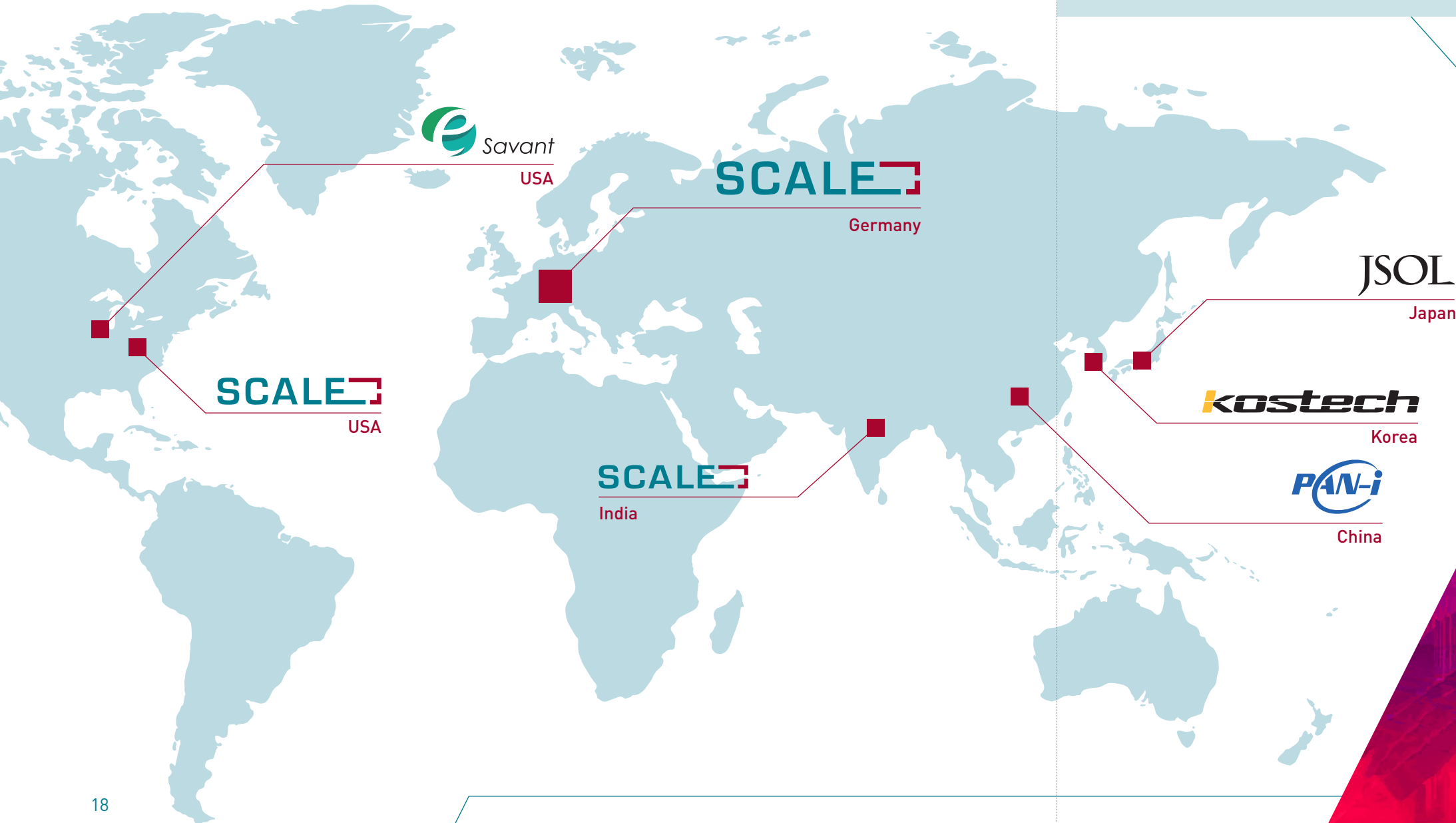


About us

YOUR TRUSTED PARTNER  
THROUGHOUT THE ENTIRE  
CAE JOURNEY

At SCALE, we specialize in advanced IT solutions for simulation data management and CAE processes. We offer a broad range of IT services, including custom software development, CAE support, and data management. Our expertise covers process management, workflow enhancement, data analysis, and numerical optimization for product design.

We actively engage in research on Machine Learning and AI applications within the automotive industry, collaborating with leading German universities and institutes. Our team of experienced CAE engineers and skilled computer scientists drives our success.



Services

We focus on your needs and collaborate to develop tailored solutions that help you achieve your goals. Our technical assistance optimizes your CAE environment.

Consulting

Enhance your CAE processes with our expertise. We translate your requirements into technical concepts and implement advanced SDM systems. Explore the possibilities of AI applications with our dedicated support.

Certified Security

We are a trusted development partner for leading automotive companies, having achieved TISAX Level 3 – the highest standard of information security – ensuring exceptional data protection and reliability.

With offices in **Germany** (Dresden, Ingolstadt, Stuttgart, Braunschweig), the **USA**, and a technology center in **India** (Jaipur), we maintain a robust network of resellers across Asia and North America.



We Are Looking Forward  
to Your Inquiry!



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