Next generation approach to Crash Simulation Optimization, incorporating CAD-Design parameters

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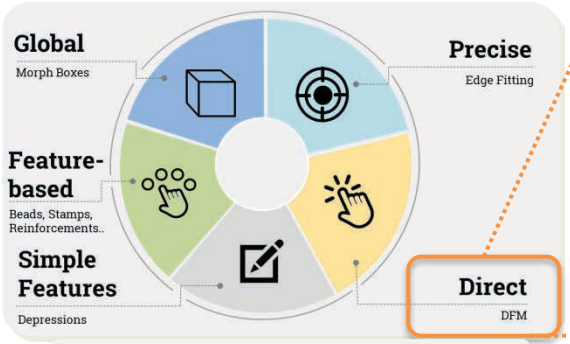
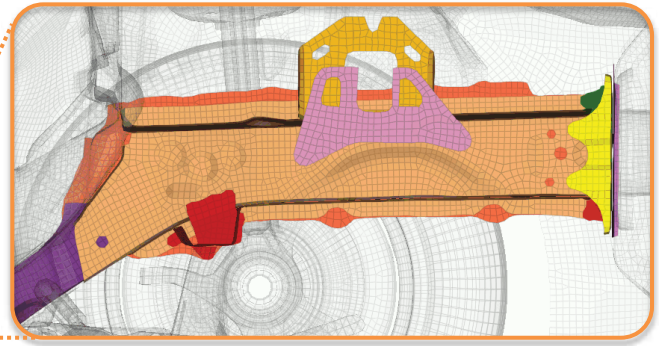
01 CAE back to CAD

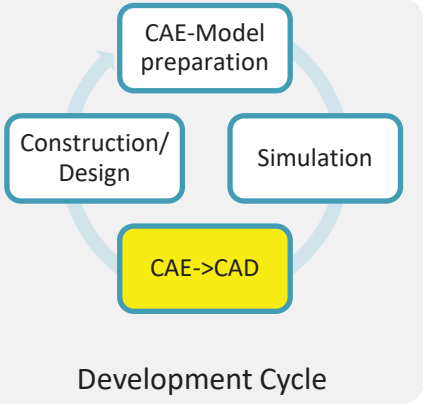


ANSA Morph & Design Toolbox

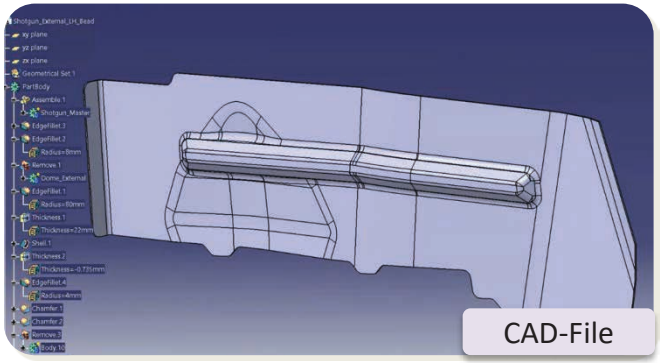


Challenge:

Transfer Design Changes that improve the CAE-Function back to the CAD-Design

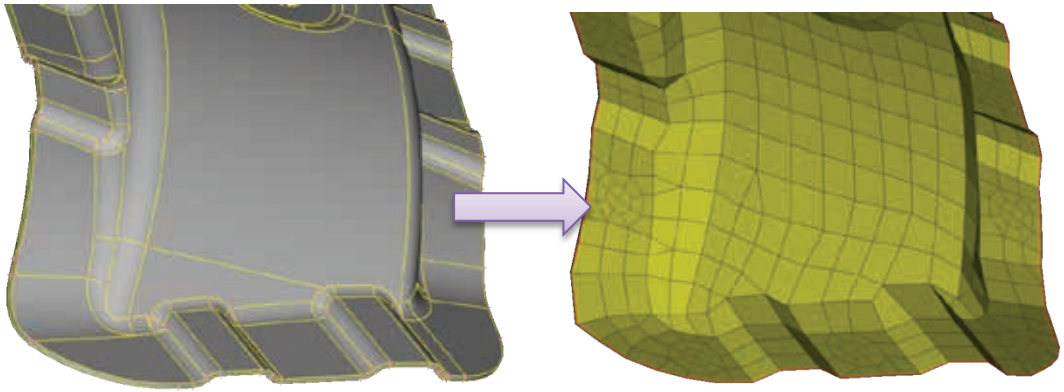


Development Cycle



CAD-File

01 CAE back to CAD

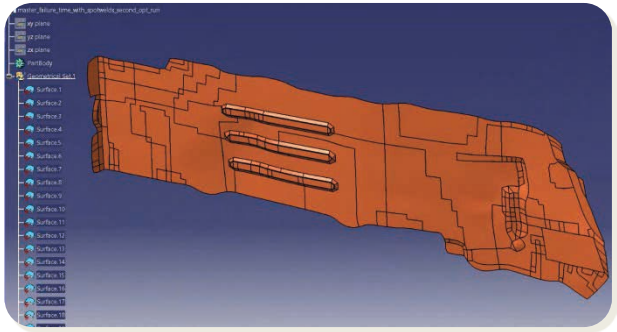


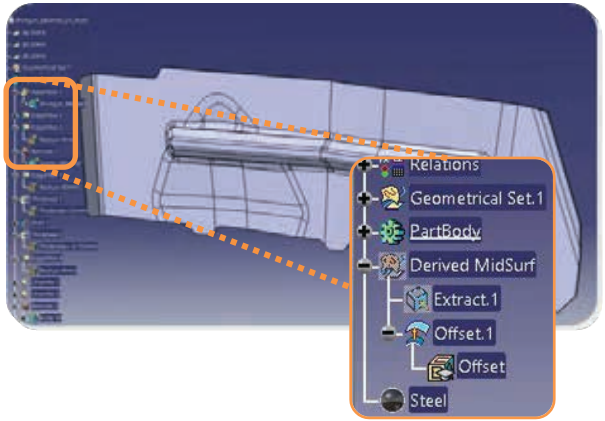
Challenge:

Transfer Design Changes that improve the CAE-Function back to the CAD-Design

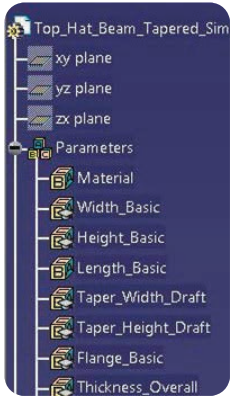
Bottlenecks:

- FE-Model is a simplification from the original CAD-Design
- GEOM-export back to CAD results in “dead” geometry
- CAD-History, Constraints and other META-Data not included



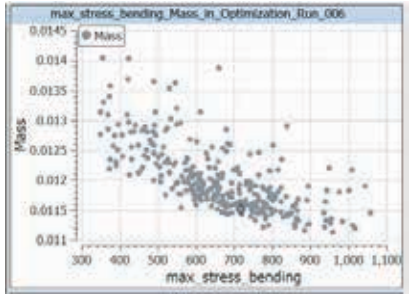


02 Approach



Design Parameters

Automation Service



2nd Optimization

Cross Platform

Scalable

Seamless integration

Strategy:

- Design Parameters added in CAD-File
- Perform a 2nd Optimization Cycle

Innovation:

- Design Parameters affected directly during the Optimization Loop

Requirements:

- Low complexity
- High automation
- Traceability

02 Approach

Strategy:

- Design Parameters added in CAD-File
- Perform a 2nd Optimization Cycle

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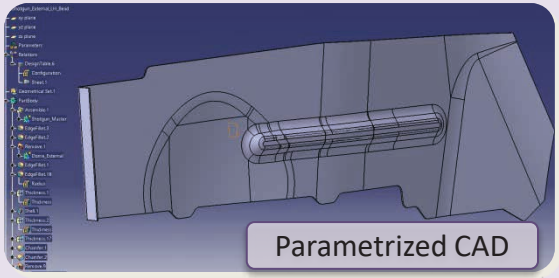
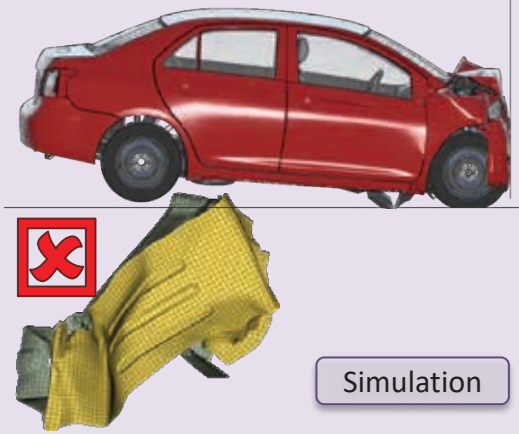
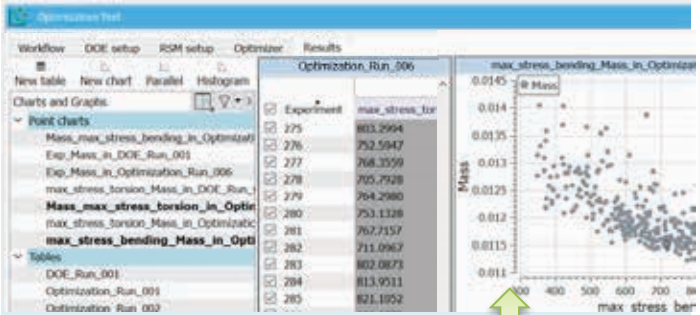
Input





Optimization Process



+Process Call

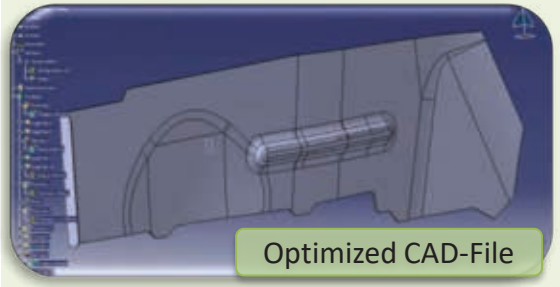
Results

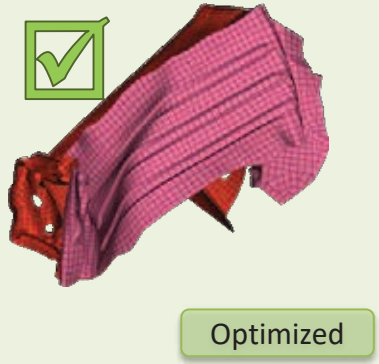
SPDRM Workflow Manager

Geom Update → FE-Update

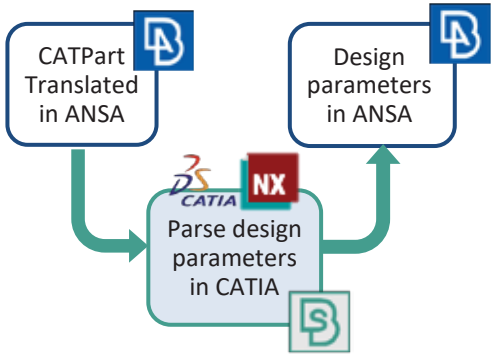
Post Processing ← Run Simulation

Result

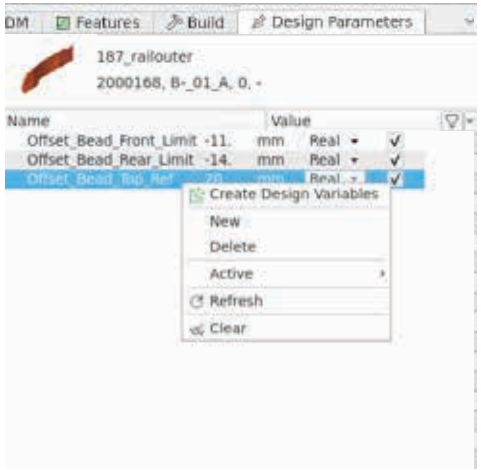


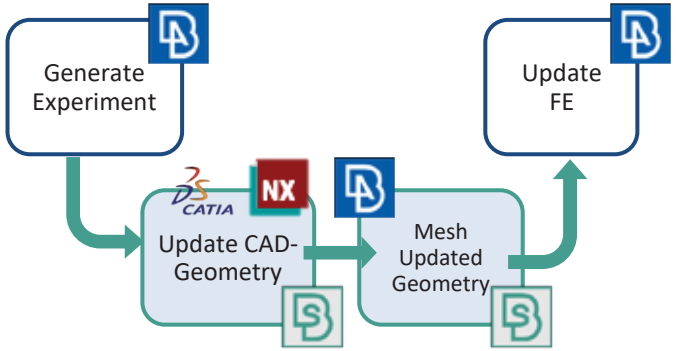


03 Implementation

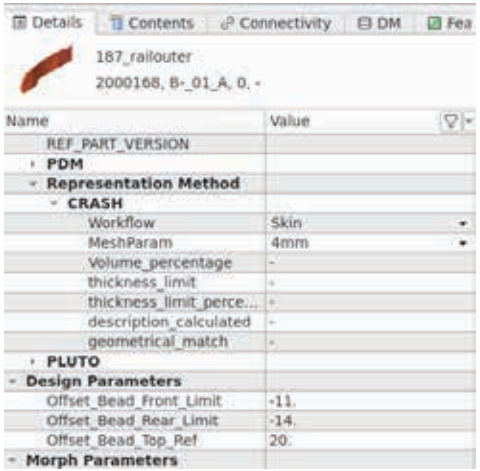


Use Case 1: Parse CAD-Parameters





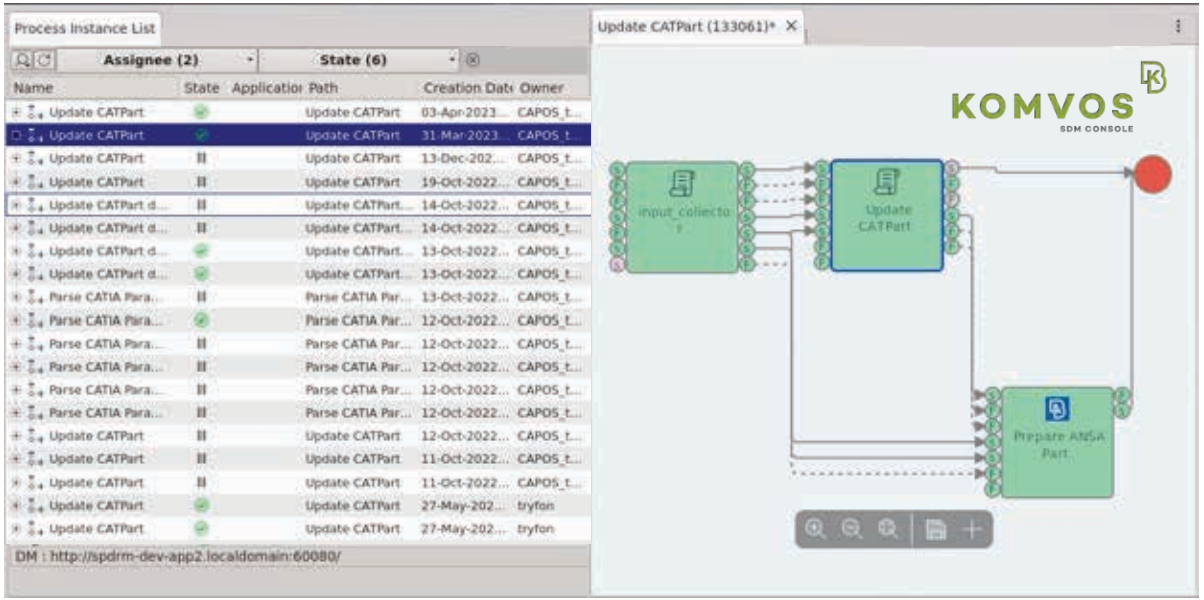
Use Case 2: Update FE



Process Design

- Automation steps captured in Process templates
- Execute time and resource consuming Tasks on Beta Apps Launchers
- Design parameters overview and Process input Parameters are integrated within Model Browser

03 Implementation



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Execution

- Communication exchange about process status with main ansa
- Access to process statistics
- Traceability of process related data and meta-data

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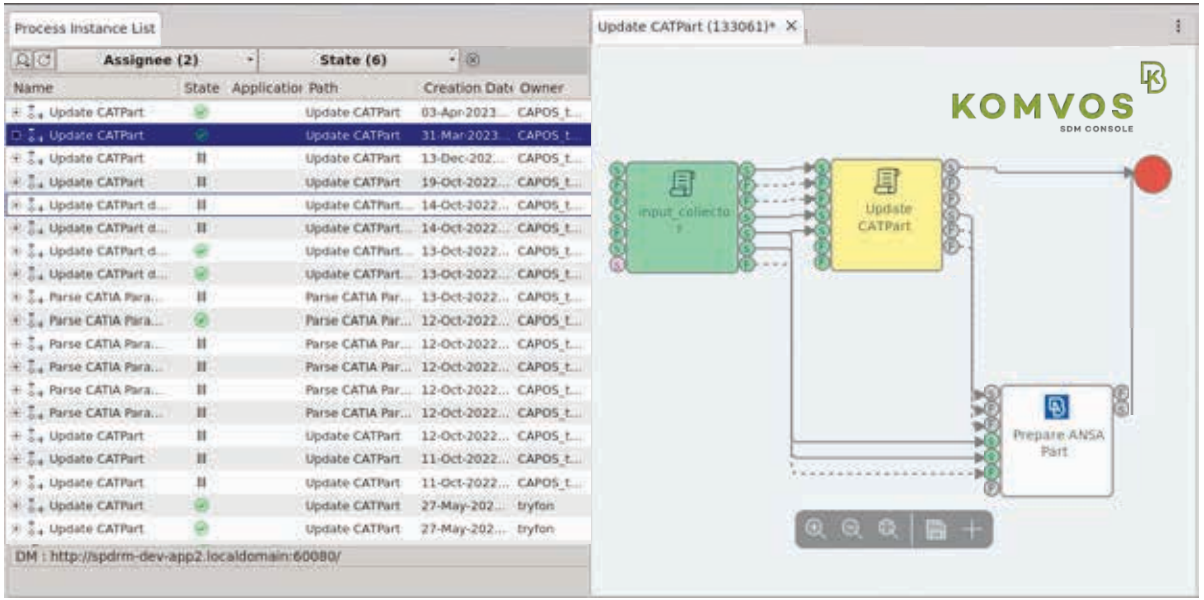

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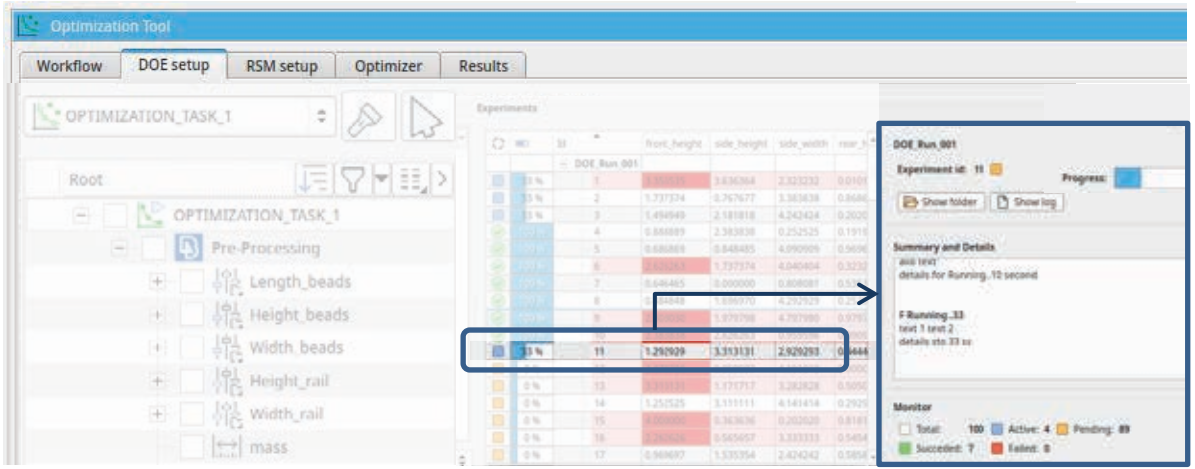

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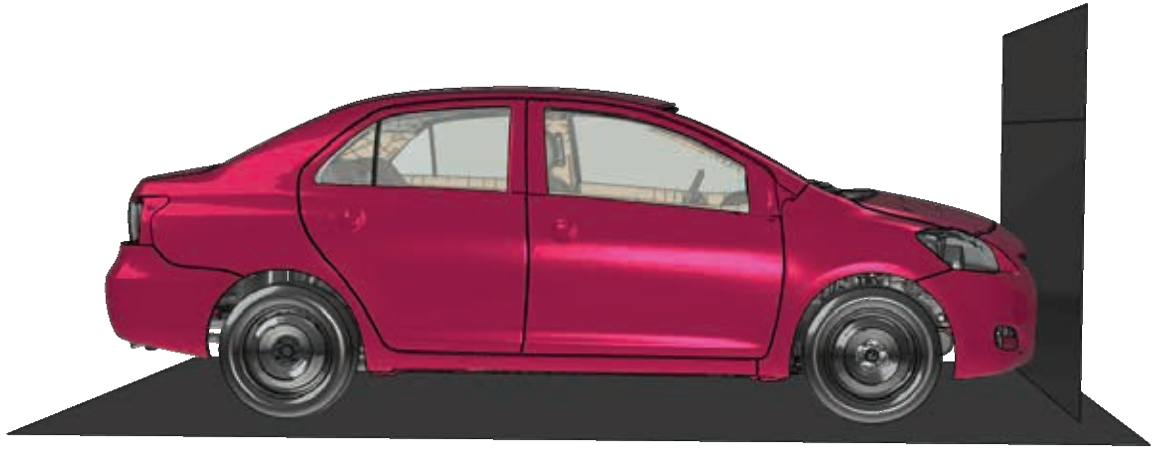
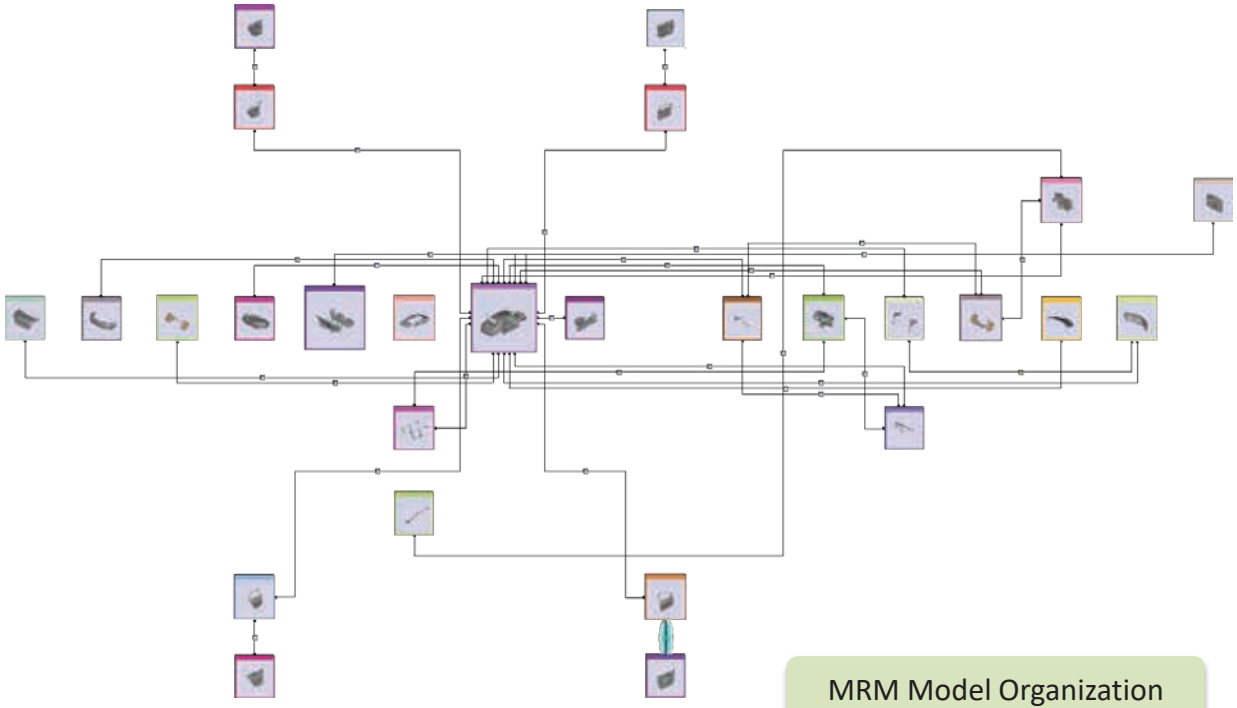
04 Example

Yaris Front Crash 56 km/h



04 Example

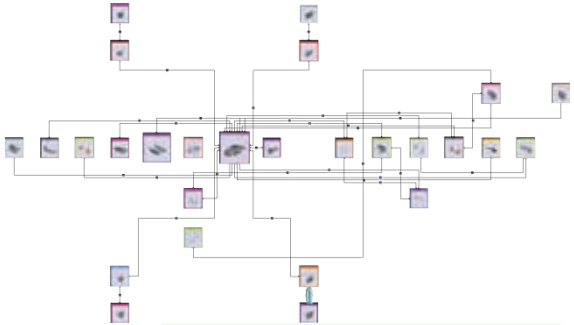


MRM Model Organization

Yaris Front Crash 56 km/h

- fmvss208_yaris_r01_sedan_001_01_01
  - Model Setup Entities
  - fmvss208_01
    - added_mass
    - contacts
    - controls
    - cross_sections
    - database
    - dummy_springs
    - gravity
    - ground
    - hourglass_cards
    - initial_velocity
    - materials
    - rigid_wall
    - rigid_wall_transformation
    - sensors
  - crash_assembly_yaris_r01_sedan_crash_001
    - 010_connections_yaris_r01___crash_fe_001
    - 100_biw_yaris_r01___crash_fe_001
    - 220_door_fl_yaris_r01___crash_fe_001
    - 230_door_fr_yaris_r01___crash_fe_001
    - 240_door_rl_yaris_r01___crash_fe_001
    - 250_door_rr_yaris_r01___crash_fe_001
    - 260_hood_yaris_r01___crash_fe_001
    - 270_trunk_yaris_r01___crash_fe_001
    - 280_windows_yaris_r01___crash_fe_001
    - 305_central_console_yaris_r01___crash_fe_001
    - 310_ip_yaris_r01___crash_fe_001
    - 315_ip_beam_yaris_r01___crash_fe_001

04 Example



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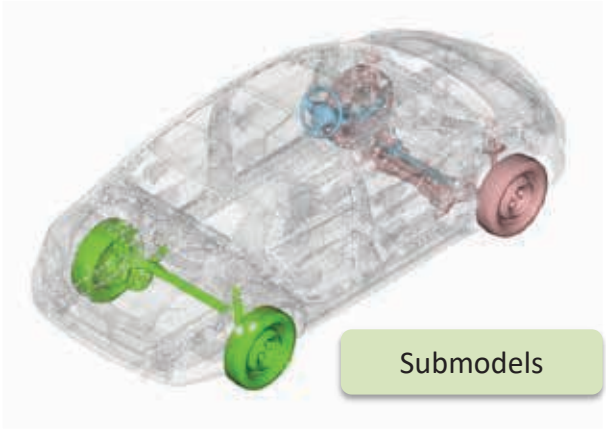
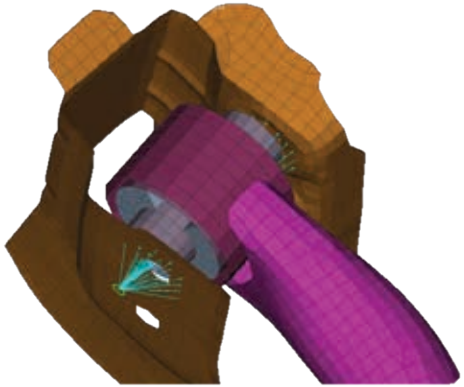
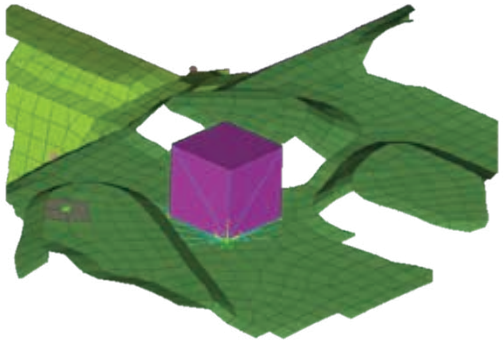


Submodels



Connectors between Modules



Output Requests

Yaris Front Crash 56 km/h

- fmvss208_yaris_r01_sedan_001_01_01
  - Model Setup Entities
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    - database
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    - gravity
    - ground
    - hourglass_cards
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    - 220_door_fl_yaris_r01___crash_fe_001
    - 230_door_fr_yaris_r01___crash_fe_001
    - 240_door_rl_yaris_r01___crash_fe_001
    - 250_door_rr_yaris_r01___crash_fe_001
    - 260_hood_yaris_r01___crash_fe_001
    - 270_trunk_yaris_r01___crash_fe_001
    - 280_windows_yaris_r01___crash_fe_001
    - 305_central_console_yaris_r01___crash_fe_001
    - 310_ip_yaris_r01___crash_fe_001
    - 315_ip_beam_yaris_r01___crash_fe_001

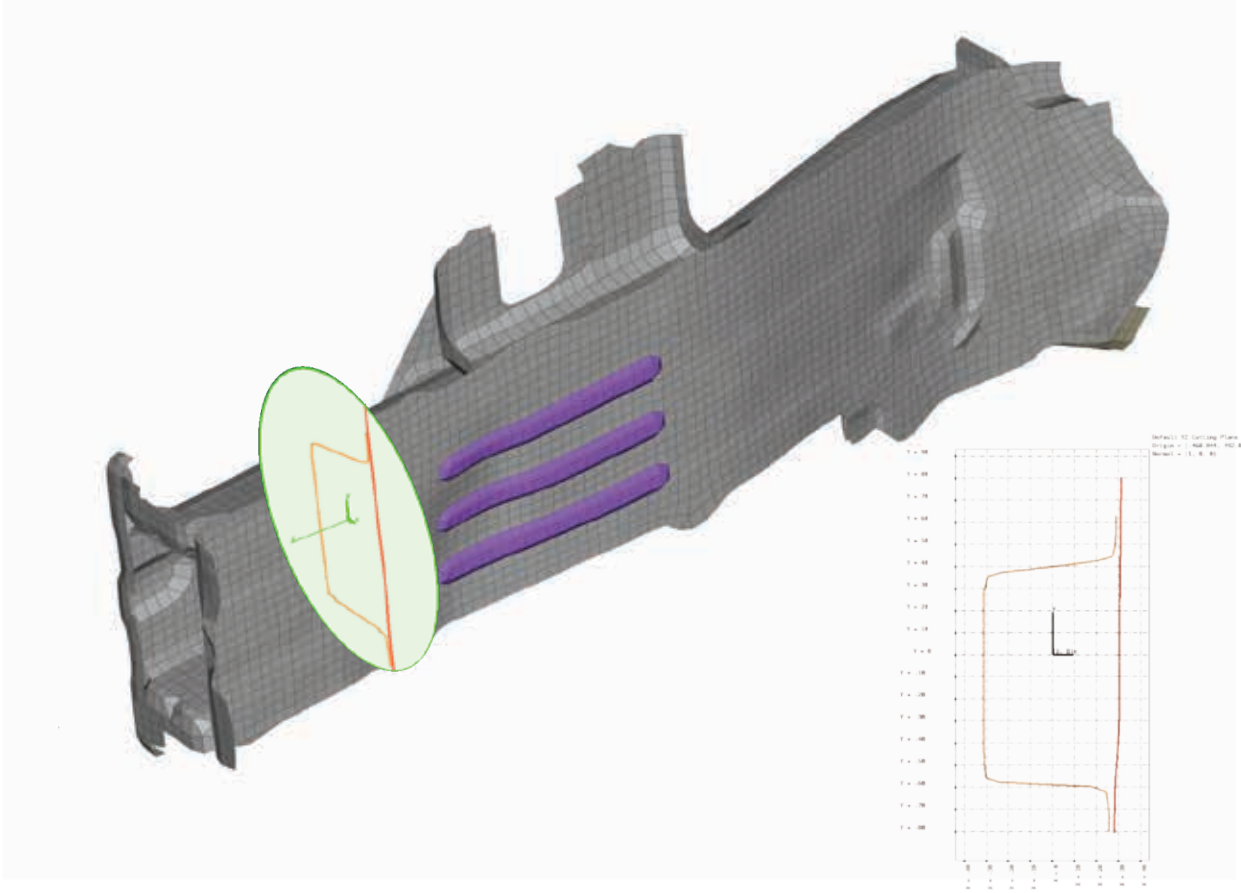
05 Optimization 1

Yaris Front Crash 56 km/h

Design Space Exploration

- Addition of Beads
- Component's Cross Section

05 Optimization 1



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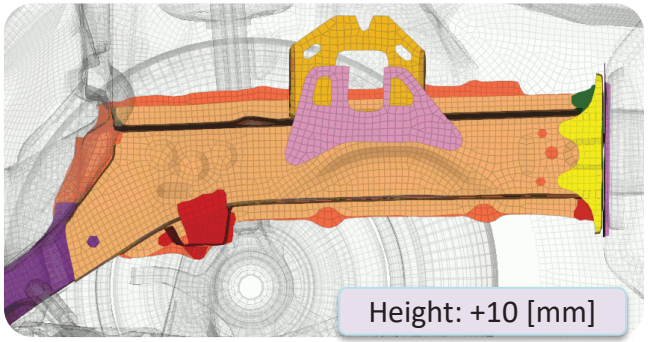

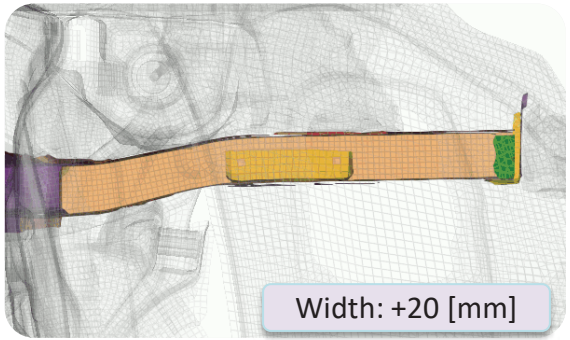

Yaris Front Crash 56 km/h

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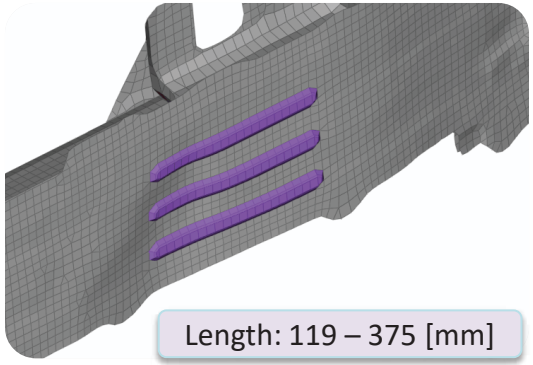
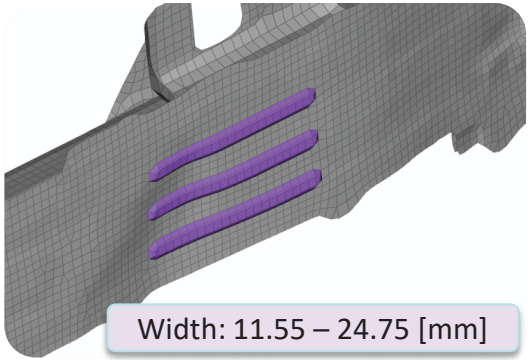
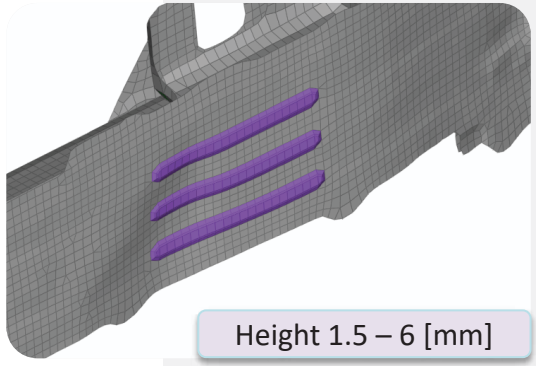
Design Variables Overview
- Cross Section Width & Height
- Bead Length, Width & Height







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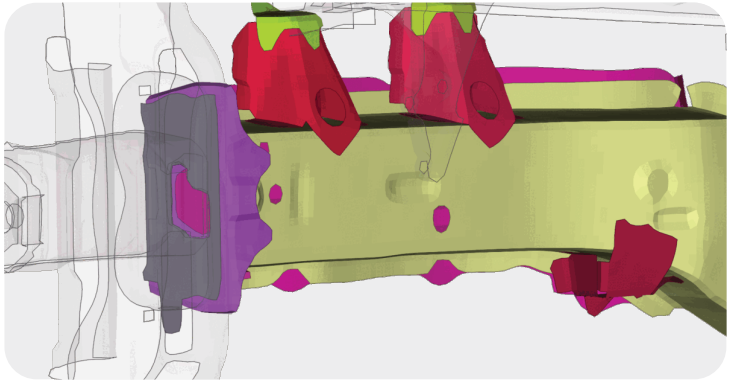
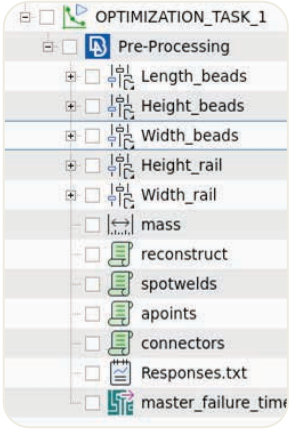
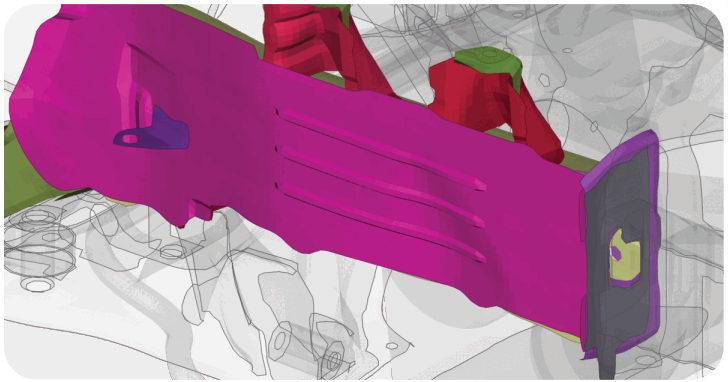
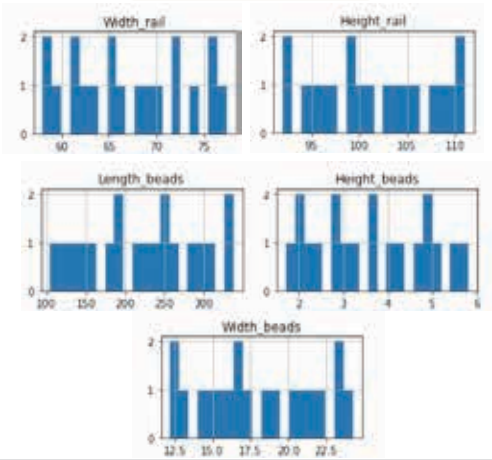








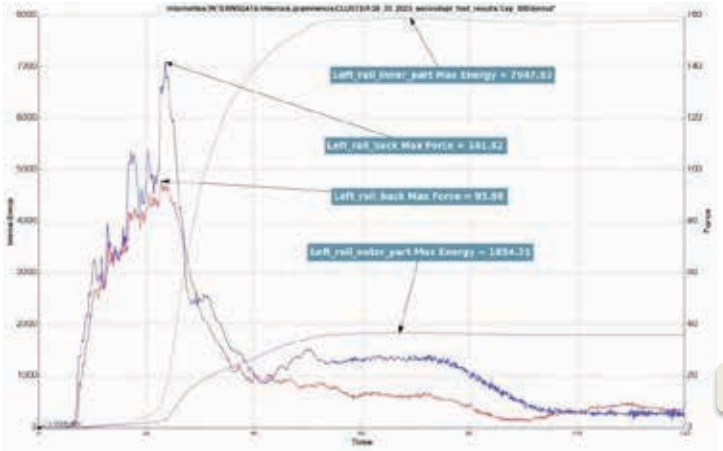
Yaris Front Crash 56 km/h

Design Space Exploration
- Addition of Beads
- Component's Cross Section

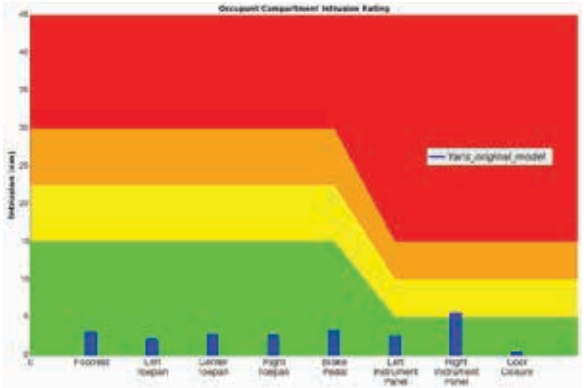
Design Variables Overview
- Cross Section Width & Height
- Bead Length, Width & Height

Design of Experiments (DOE)
- 20 experiments

05 Optimization 1



Key Results on Cross Sections



IIHS Structural Rating

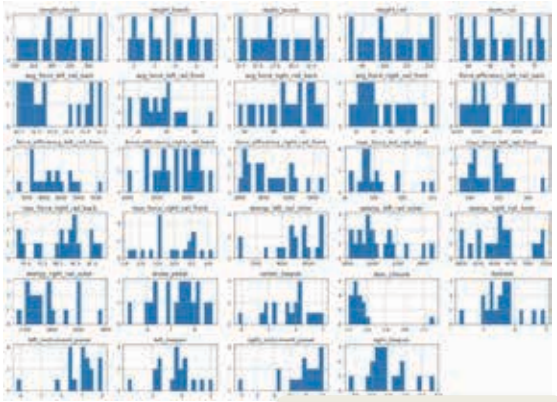
Yaris Front Crash 56 km/h

Design Space Exploration
- Addition of Beads
- Component's Cross Section

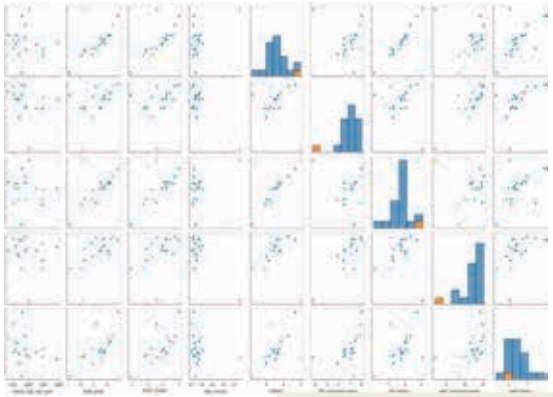
Design Variables Overview
- Cross Section Width & Height
- Bead Length, Width & Height

Design of Experiments (DOE)
- 20 experiments
- Key results: Intrusions based on IIHS protocol and Cross Section force values

05 Optimization 1

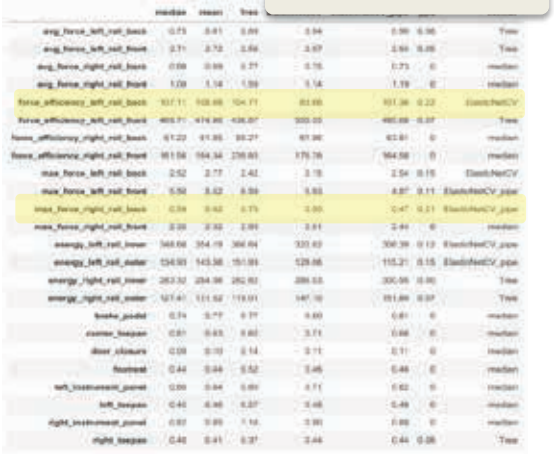


Distribution Plots



Scatter Plots

Correlation Matrix



Predictive Power Score

Yaris Front Crash 56 km/h

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- Component's Cross Section

Design Variables Overview

- Cross Section Width & Height
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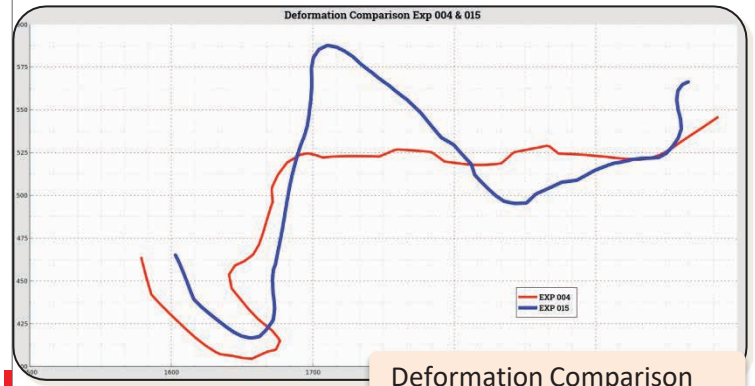
Design of Experiments (DOE)

- 20 experiments
- Key results: Intrusions based on IIHS protocol and Cross Section force values
- Predictive Metrics

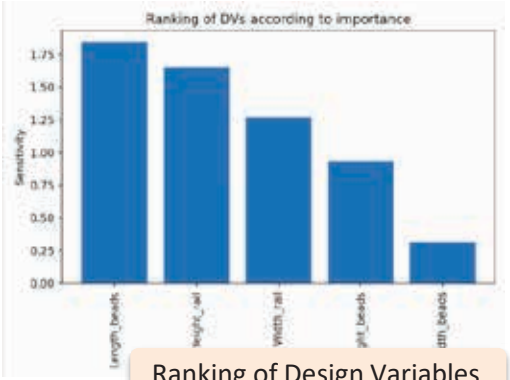
05 Optimization 1

Exp 004

Exp 015



Deformation Comparison



Ranking of Design Variables

Yaris Front Crash 56 km/h

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- Addition of Beads
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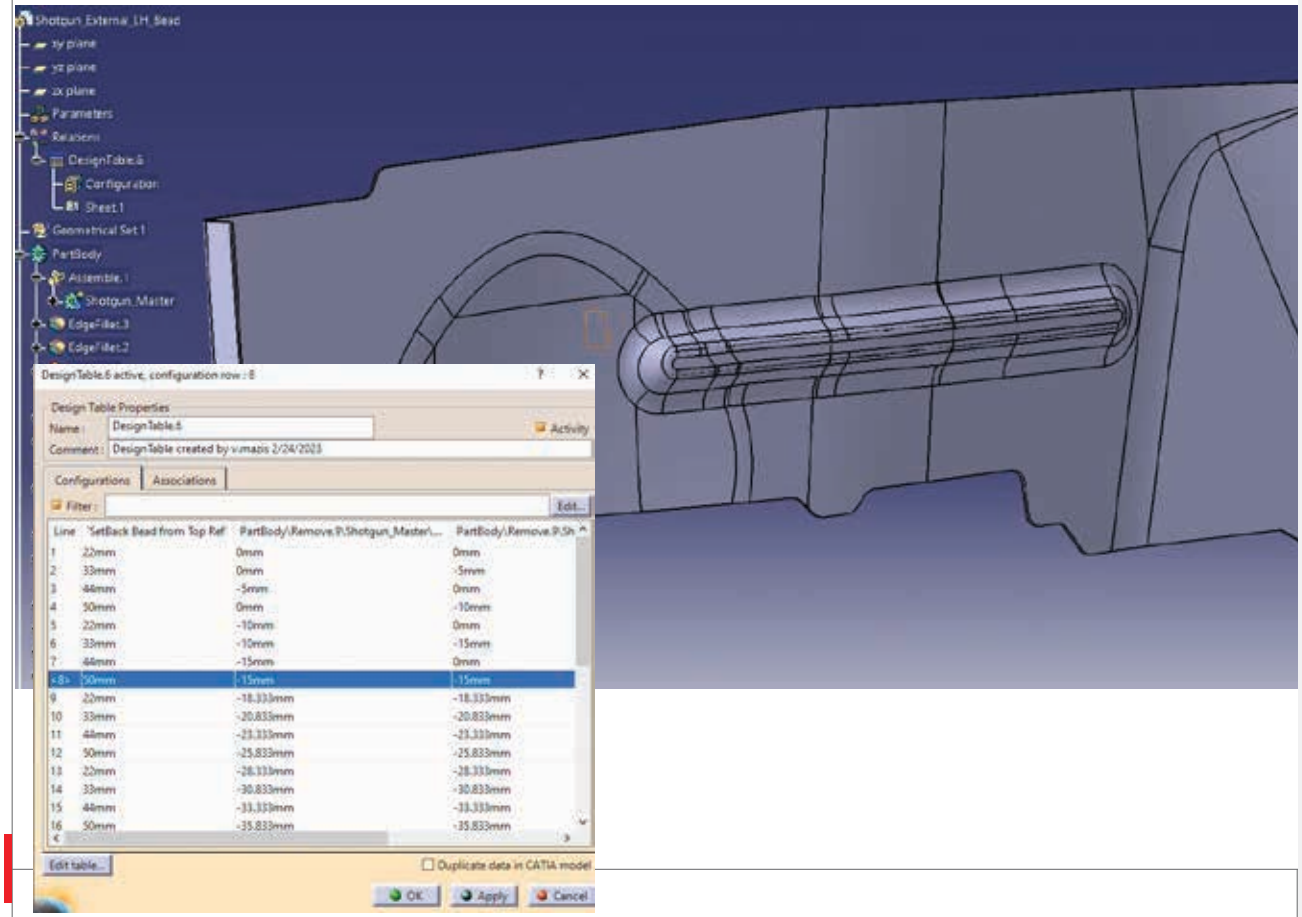
Design of Experiments (DOE)
- 20 experiments
- Key results: Intrusions based on IIHS protocol and Cross Section force values
- Predictive Metrics

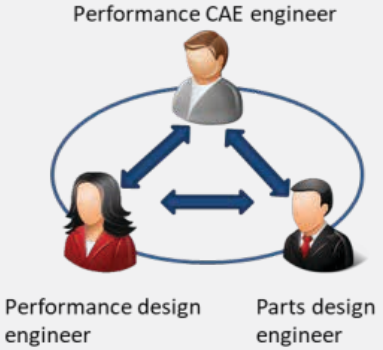
Decision Making
- ML-Based Predictive tools utilized

06 New CAD Version

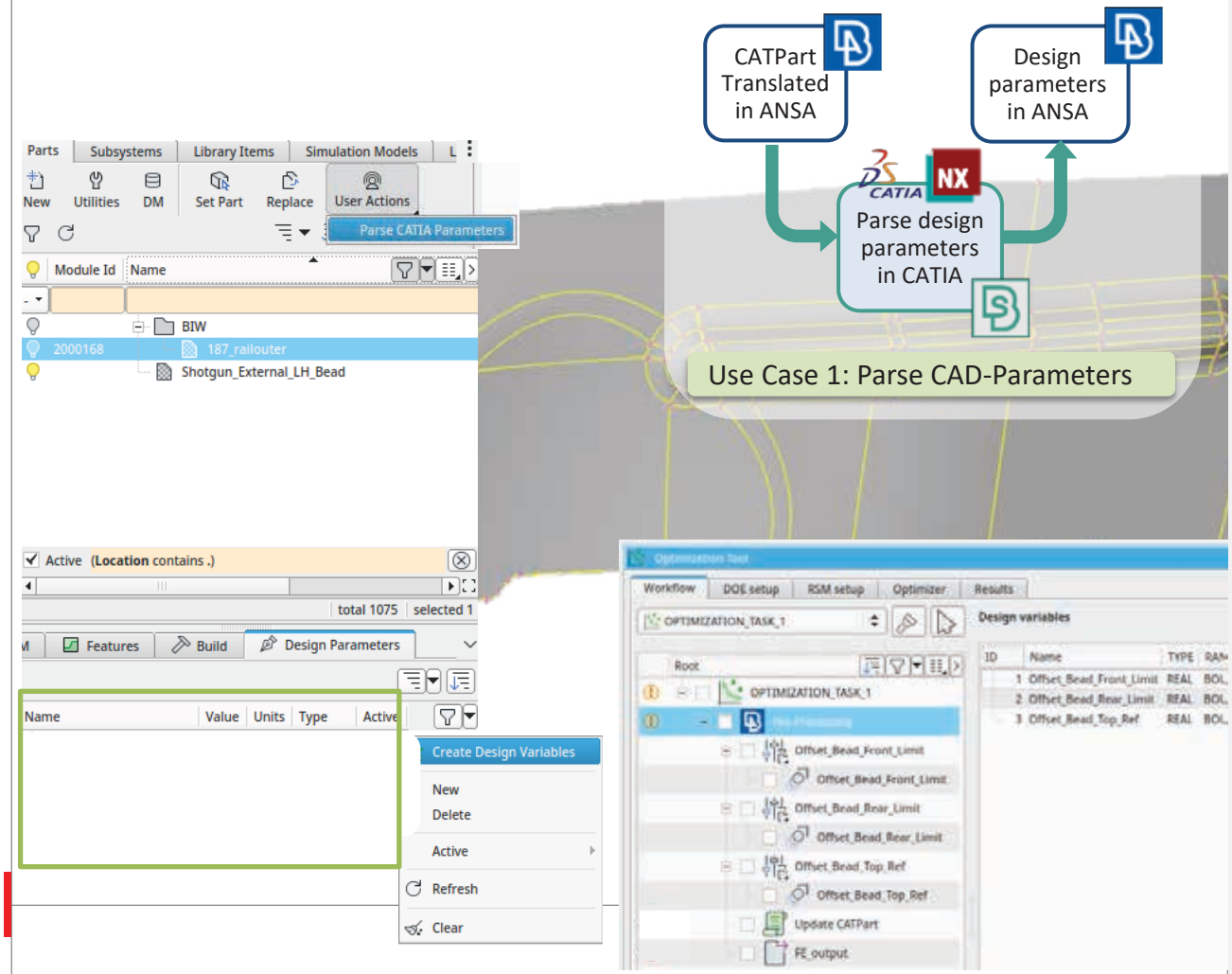


CAD Design Parameters

- In collaboration with CAD-Design team, Design Parameters are added
- The Final design deviates from the original CAE-Engineers proposal, due to various limitations



07 2nd Optimization



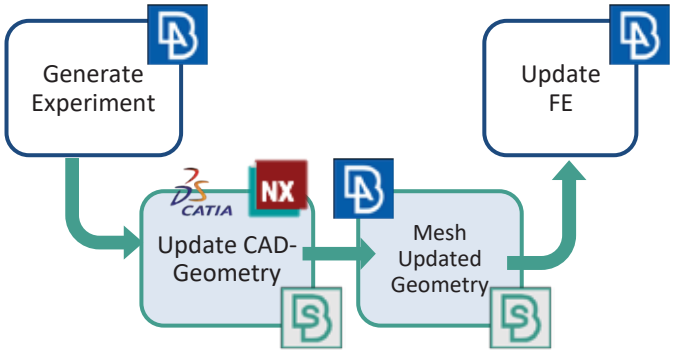
CAD Design Parameters

- In collaboration with CAD-Design team, Design Parameters are added
- The Final design deviates from the original CAE-Engineers proposal, due to limitations
- For a CATIA, a Design Table is prepared providing all parameters eligible for this optimization

Workflow Preparation

- Parse CAD-Parameters
- Create Design Variables
- Include the Update Catpart Call

07 2nd Optimization



Use Case 2: Update FE

CAD Design Parameters

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Workflow Preparation

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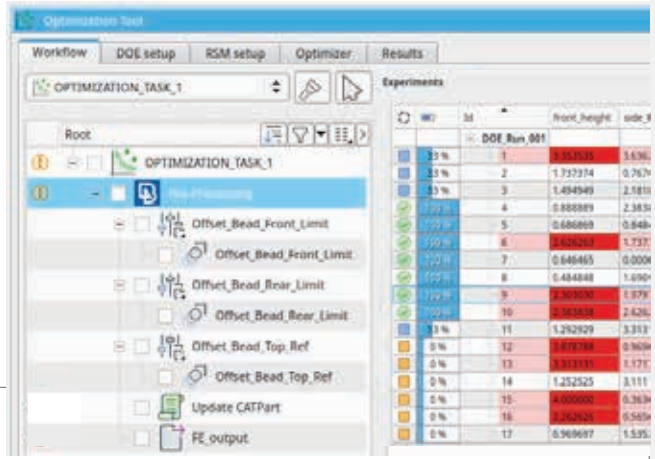
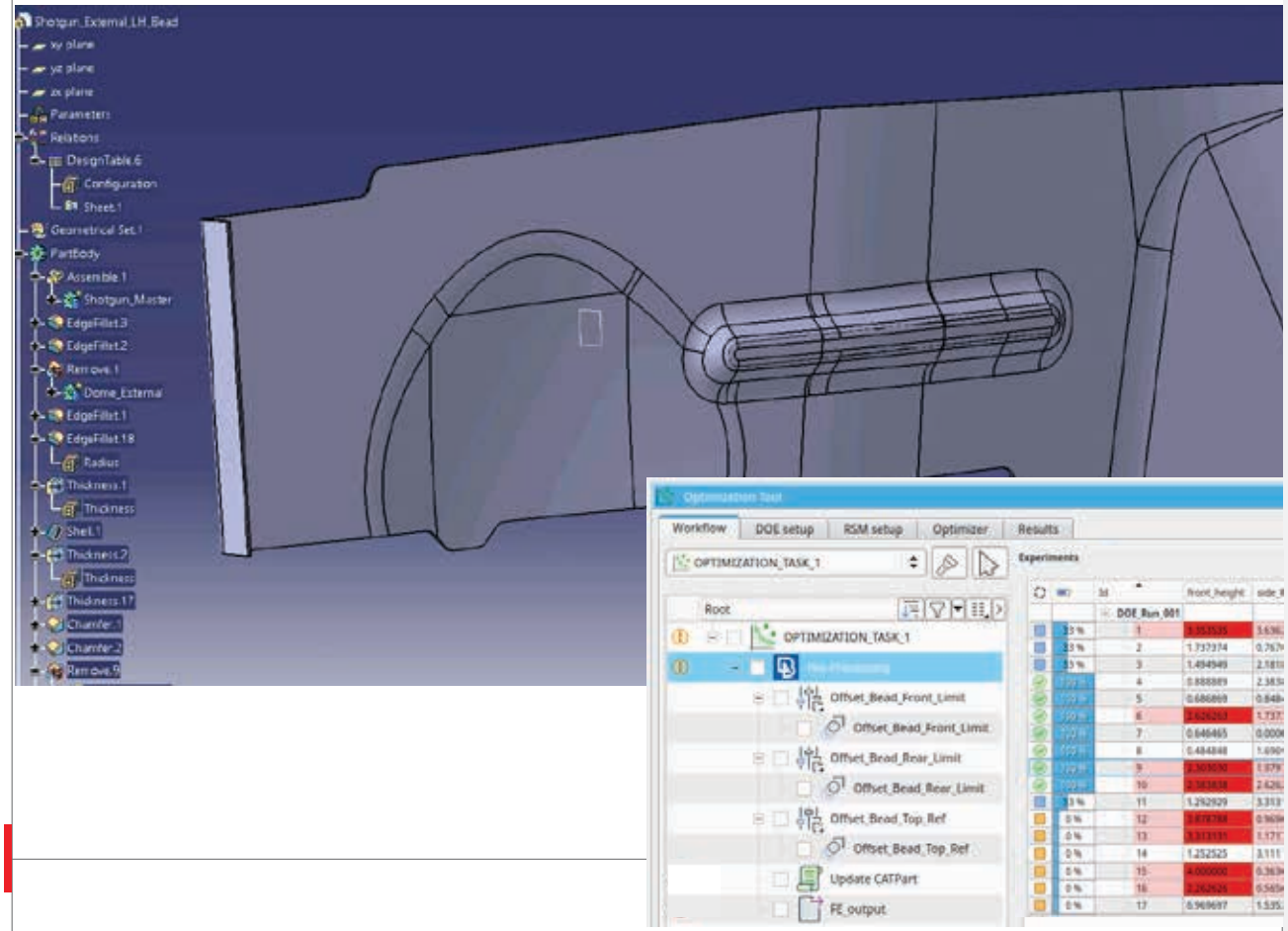
- Include the Update Catpart Call

DOE Execution

- Update-FE action is run Per Experiment production



07 2nd Optimization



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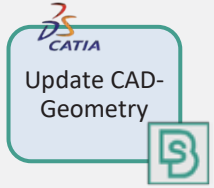
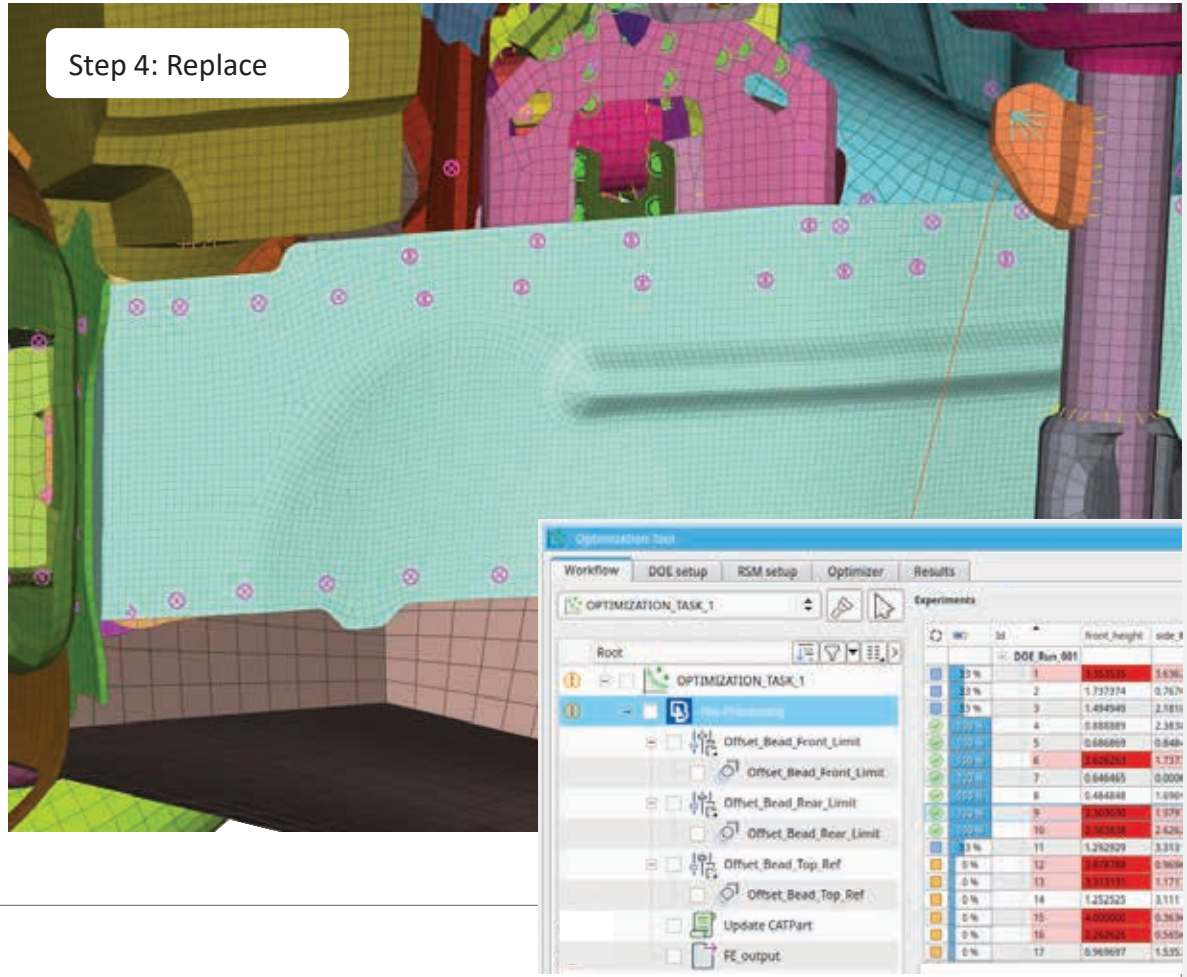
- Include the Update Catpart Call

DOE Execution

- FE-Update action is run Per Experiment production



07 2nd Optimization



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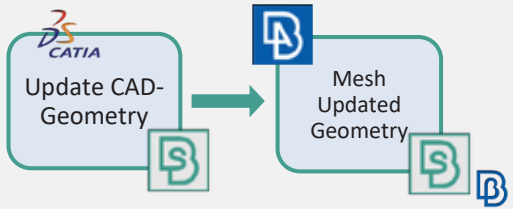
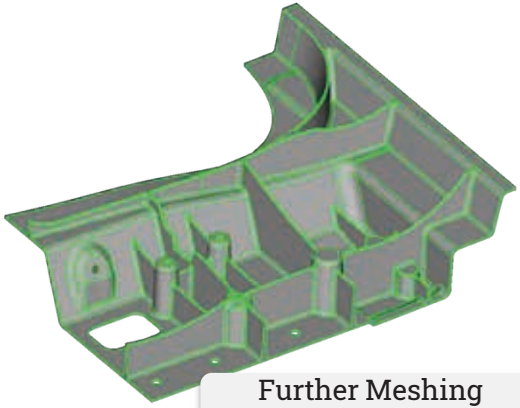
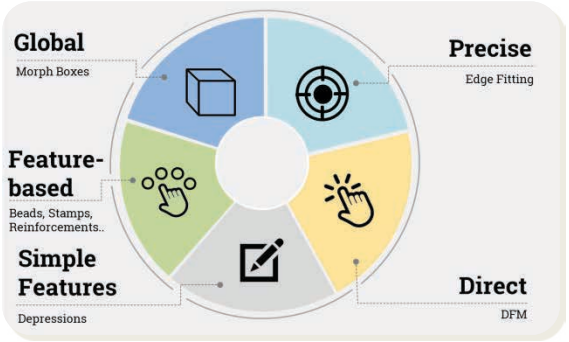


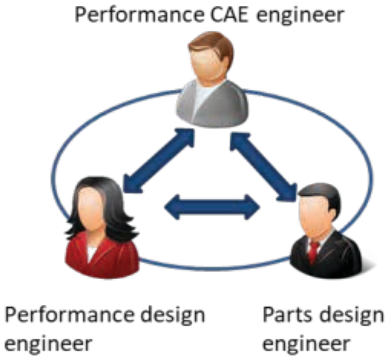
08 Next Steps



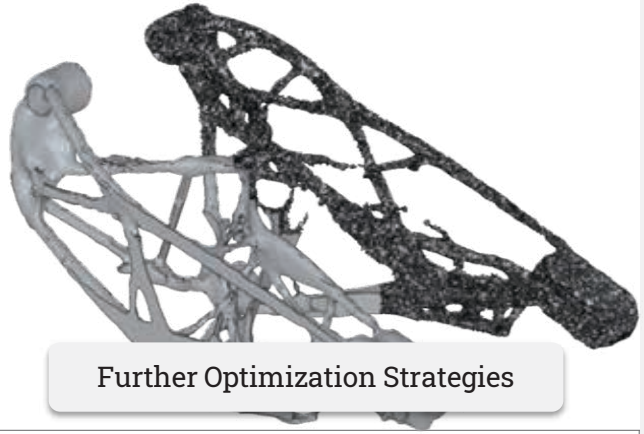
Further Meshing Strategies



ANSA Morph & Design Toolbox



Improve CAD-CAE Communications



Further Optimization Strategies

BETA

SIMULATION SOLUTIONS

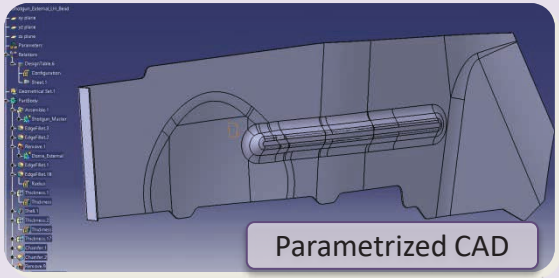
Stay connected

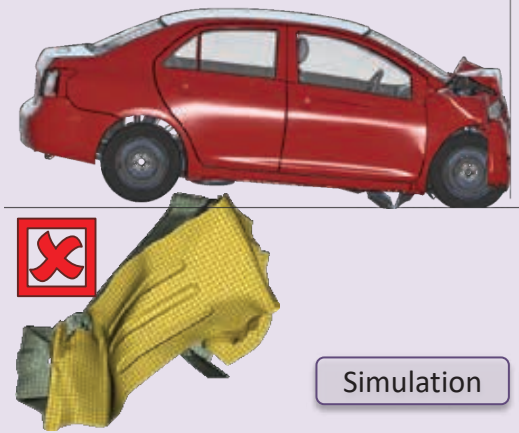
Thank you!

www.beta-cae.com

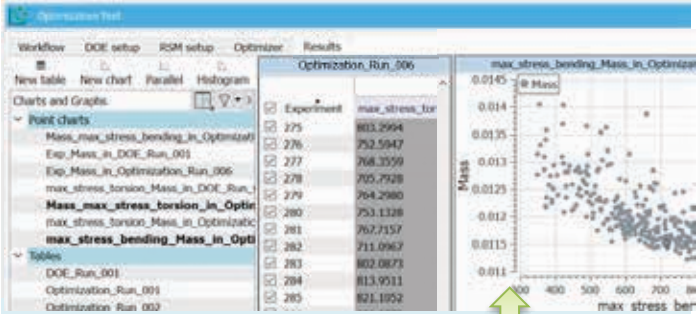
09 Closing Slide

Input





Optimization Process



+Process Call

Results

SPDRM Workflow Manager

Geom Update → FE-Update

Post Processing ← Run Simulation

Result