CAE Driven Development as a Strategic Tool

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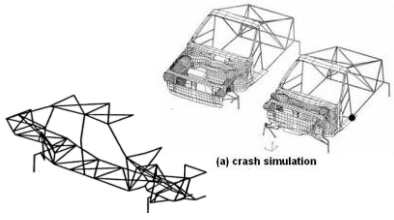
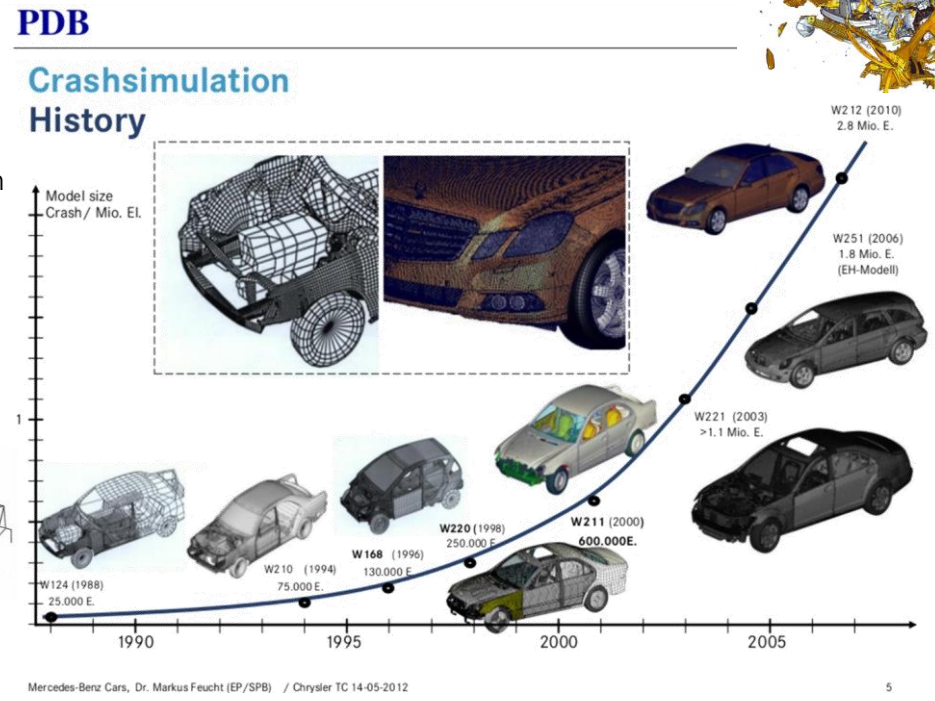
Trend in Crash Simulation

70th : Simulate car crash events with non-linear spring-mass systems
80th : First successful car crash simulation: Volkswagen Polo (ESI 1986).





~1 000 000 000 (solid elements)

~40 000 000 (solid & shell elements)

Important and necessary trend but…

CAE has been pushed to late phases and verification.

Front Loaded and Knowledge Driven Process

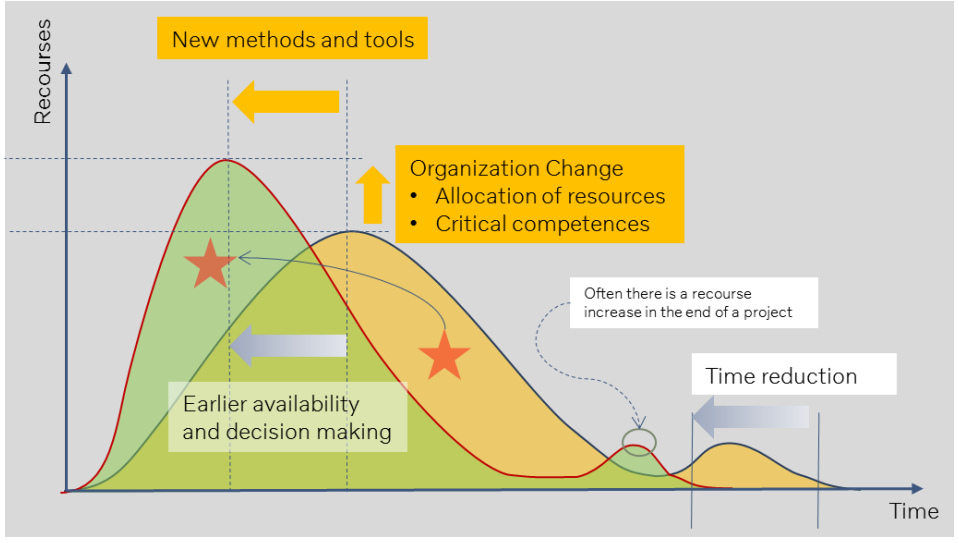
Have you ever heard of “**Front loading**”, “**Up front**”?

How hard can it be to shift CAE to early phases?

Models developed for verification in late phases is usually not suitable due to CPU time, lack of parameterization, etc.

Changing to a front loaded process usually require:

- **organizational changes**
- **new competences and resources**
- **new methods, tools and models**



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”To early to do weight optimization!”

What is ”Optimization” according to us

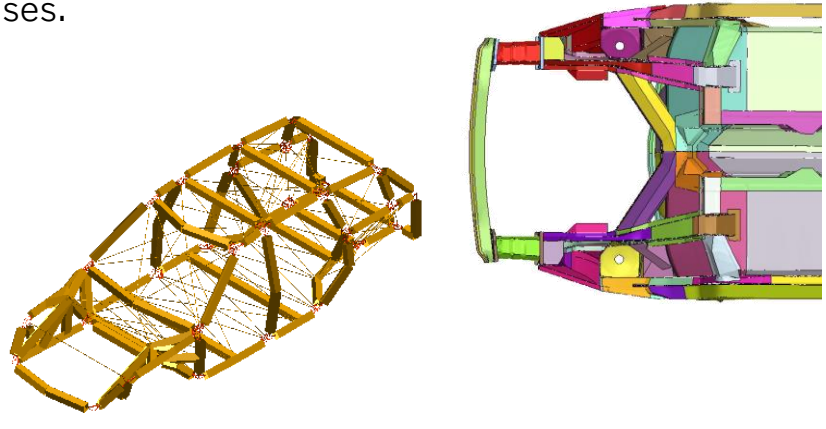
Many people equalize optimization with ”tuning”.

This can be true in late development phases.

However, models developed for verification analysis is usually not suitable for optimization due to limited design freedom, CPU time, lack of parameterization, etc.

We see on optimization as a **tool to build knowledge** in early phases.

We need models that support **cross attribute analysis** activities, **answers relevant questions** and supports the hardware development in strategy and concept phases



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”We need to secure all other attributes first”

Optimization can be used to secure and balance attributes

See them as your constraints

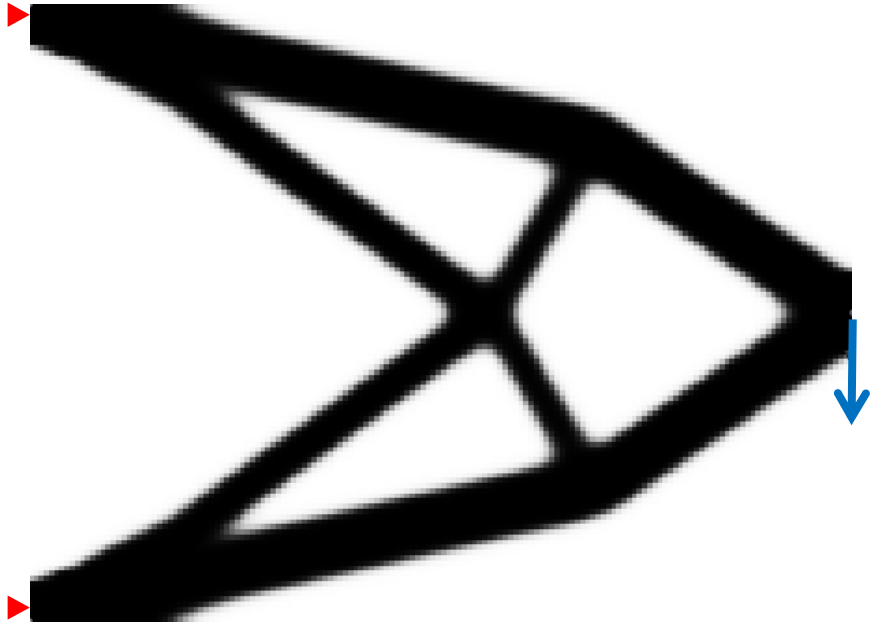
Spend time defining your optimization problem!

Min	***Objective***	*e.g. Mass*
s.t.	***Constraints***	*e.g.* $Stiffness_i > S_i$
		$Compliance_j > C_j$

(i = selected load case nr)

Optimization Challenge:

Sketch optimum material distribution using ~30% surface fill for maximum stiffness structure.

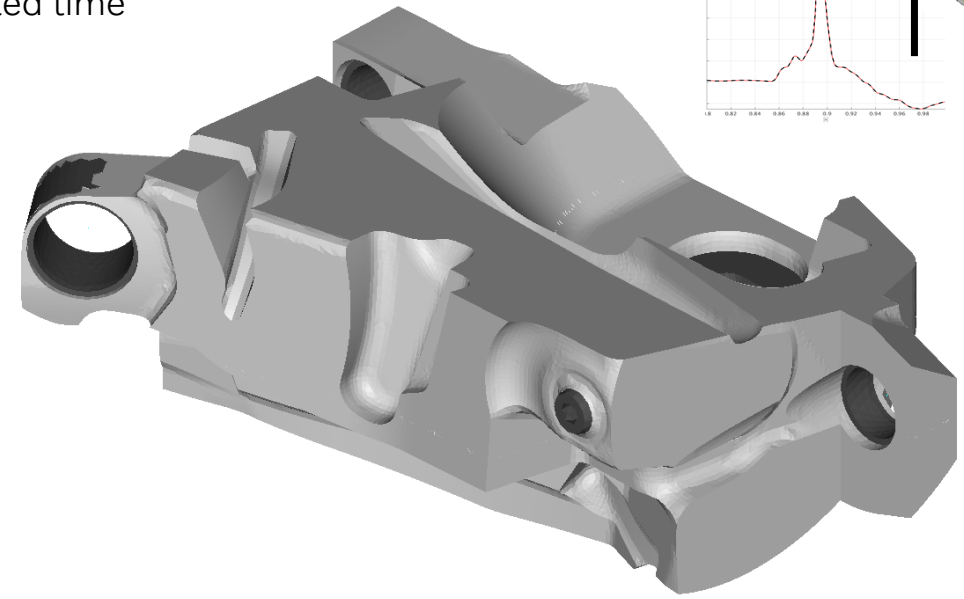


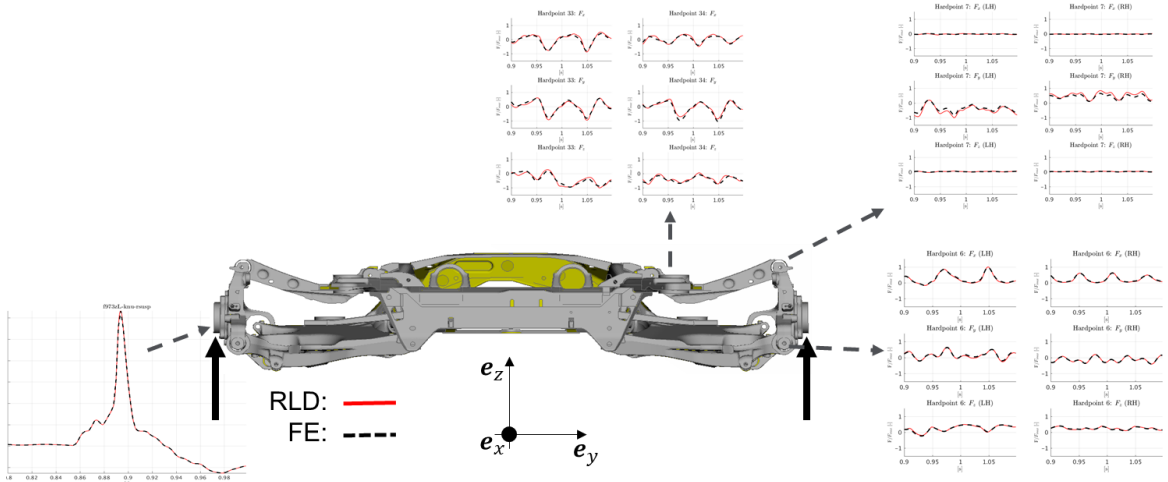
- **2D**
- **One load case**

But not trivial!

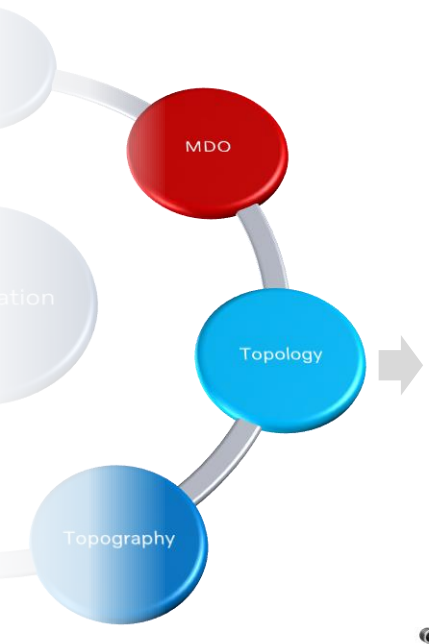
The Reality

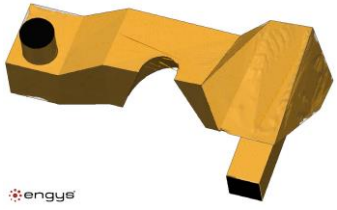
Complex loading condition
Multiple requirements
Complex 3D design space
Limited time
...



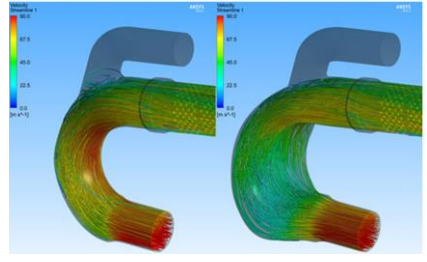


Topology Optimization

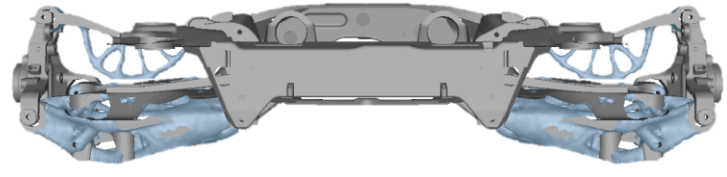


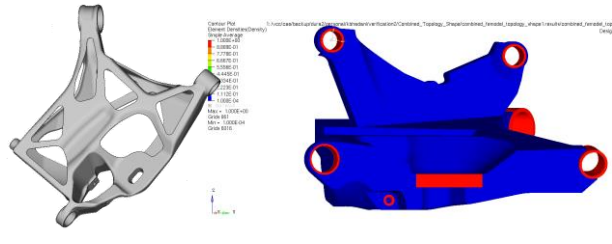


Original design Optimized design

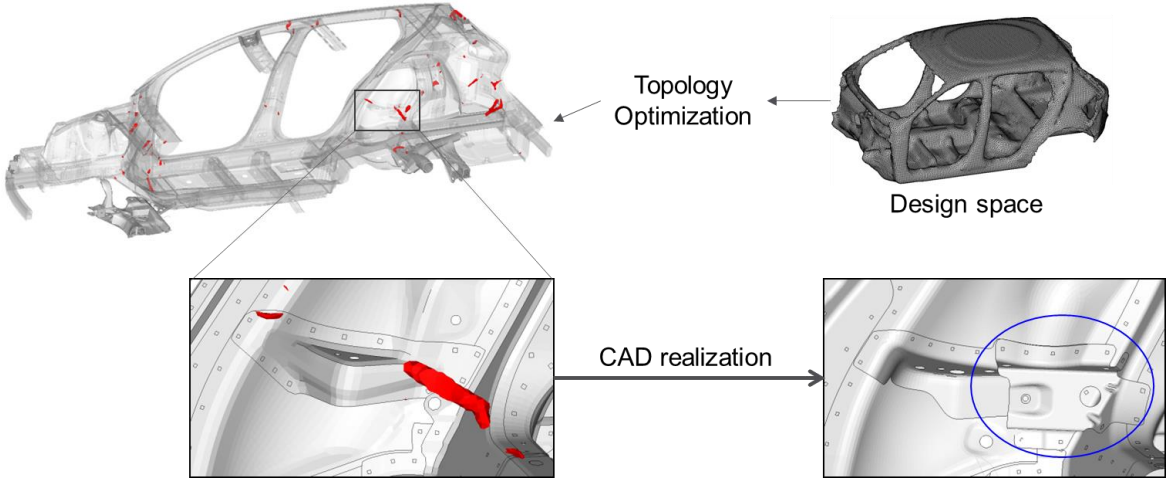


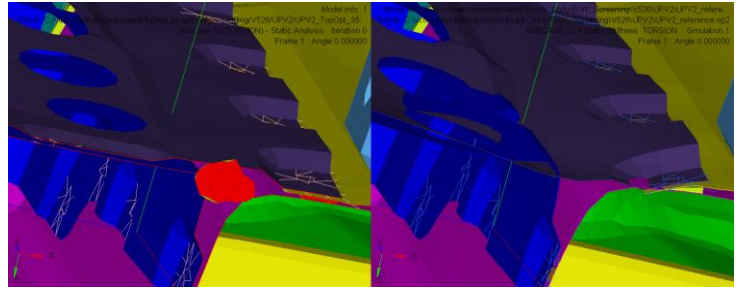
Presented at Ansys Automotive World Congress.
Recieved "Best Body and Chassis Simulation" at the Conference.

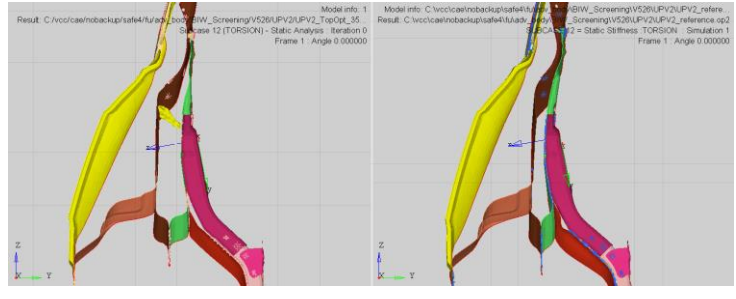




Screening using Topology Optimization







Common Misunderstandings

Optimization = Fine tuning!	FALSE	Optimization methods applied early phases builds knowledge
We need to secure all other attributes before we start weight optimization!	FALSE	Weight optimization can be used as a tool to secure other attributes.
Light weight is always related to increased cost	FALSE	Optimization in early phases leads to minimum use of material → low weight and low cost. And it also saves time!
CAE driven development is only for simulation experts!	FALSE	Many CAD tools today have simulation and optimization capabilities. Design engineers can pre-optimize their components with support from CAE experts.
Its just to buy an optimization software and start optimizing!	FALSE	Sorry. It is not that easy! You need to set a **culture of CAE driven development and secure awareness, requests and collaboration**.

Optimization Culture Arena

A cross-technical network to strengthen the internal competence and move into more CAE driven development

Open Arena

- Environment for creativity, knowledge exchange, education, etc.

Method Development

- New optimization methods and tools, templates/guidelines, ...

CAD/CAE

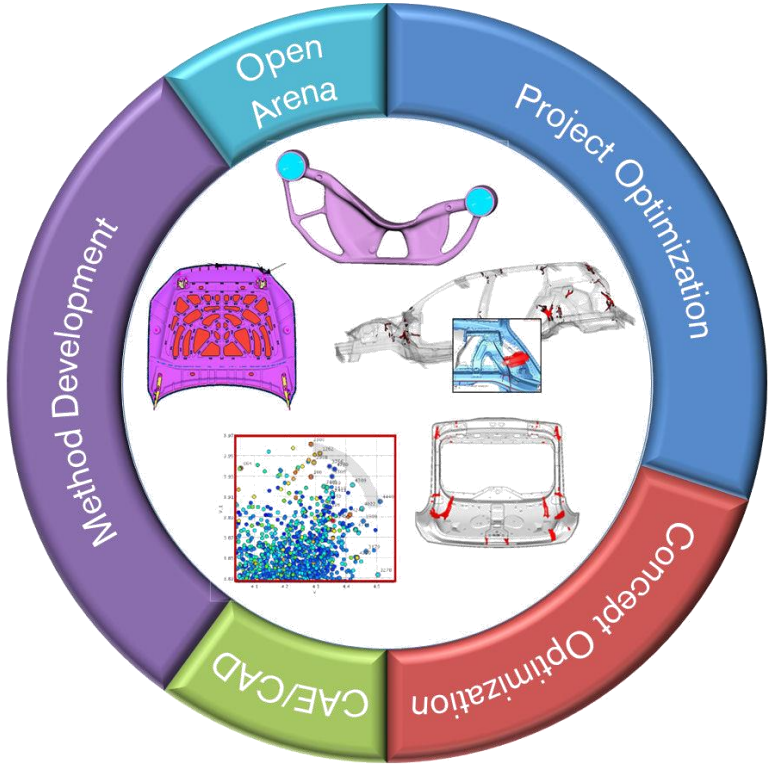
- Optimization together with, or performed by, the design engineers

Concept Optimization

- Architecture and concept optimization in the early phases.

Project Optimization Planning

- Optimization as a natural part of our project development process.



LIGHTer Product Optimization

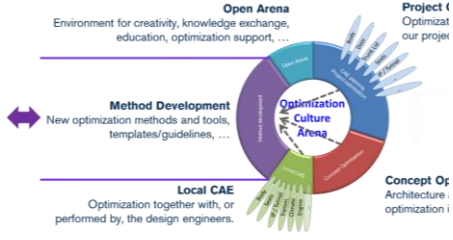
Aim

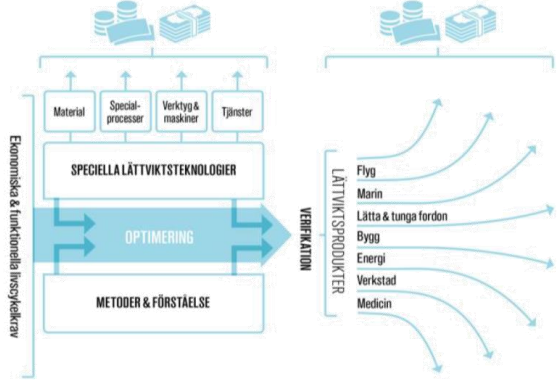
National network, development of methods, tools and processes for optimization driven development

Strengthen national competiveness.

Network activities phase 1

- Establish network, understand roles, demands and future challenges
- Develop State-of-the-Art report on product optimization
- Produce web based education
- Facilitate two workshops each year
- Contribute to upcoming LIGHTer agenda
- Coordinate research need





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