

# Optimization As Driver For Innovative Lightweight Solutions



**3DEXPERIENCE<sup>®</sup>**

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Industry: Electrification & Advanced Lightweighting Techniques  
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# Product Innovation Challenges

## Performance Requirements

Aesthetics

Stopping power

Cost

Brake fade

Manufacturability

Disc warping

Warranty



Dynamics

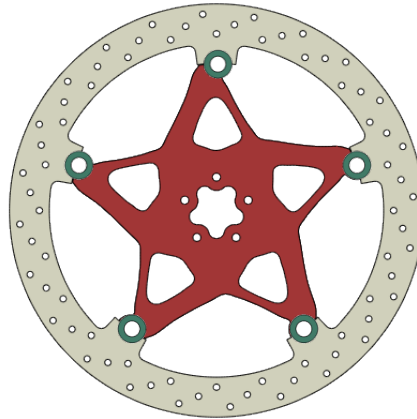
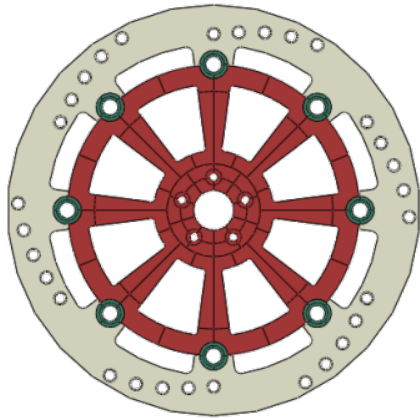
Brake squeal

Corrosion

Vibrations

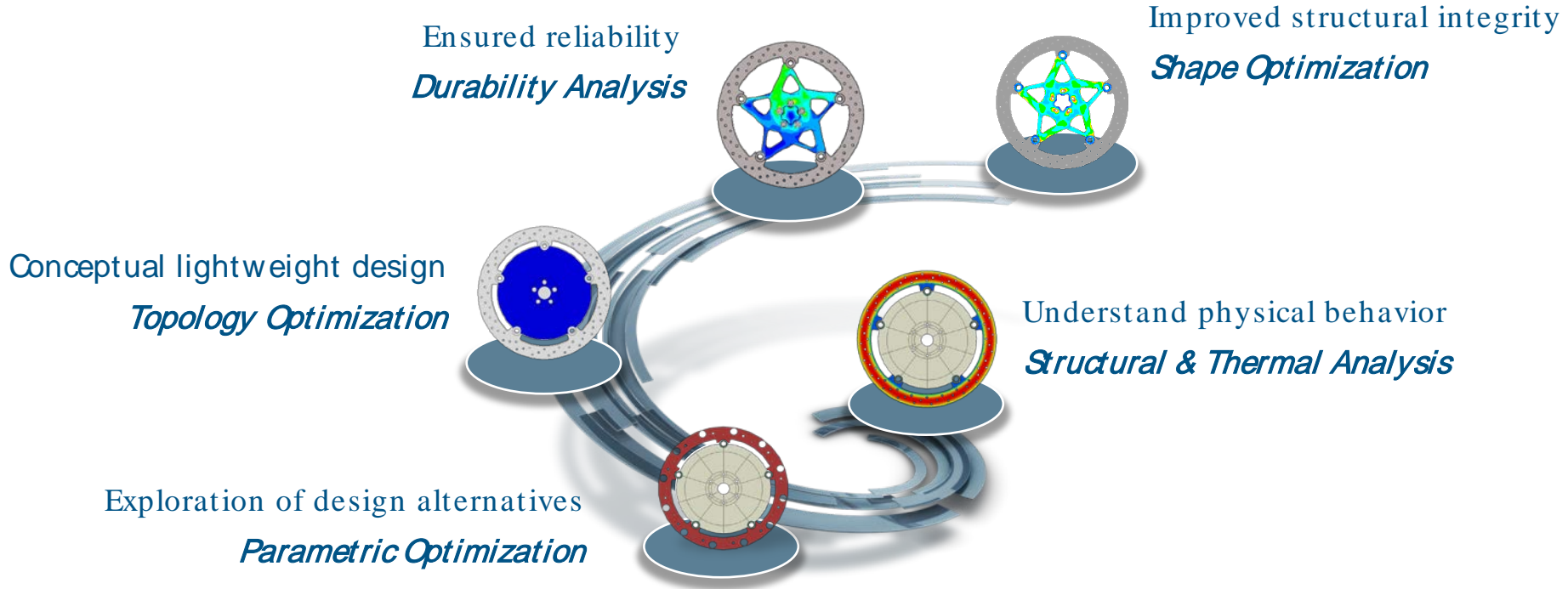
# Optimization Driven Design Evolution

## Motorcycle Brake Rotor



- ✓ Efficient cooling
- ✓ Less weight
- ✓ Higher stiffness
- ✓ Improved durability

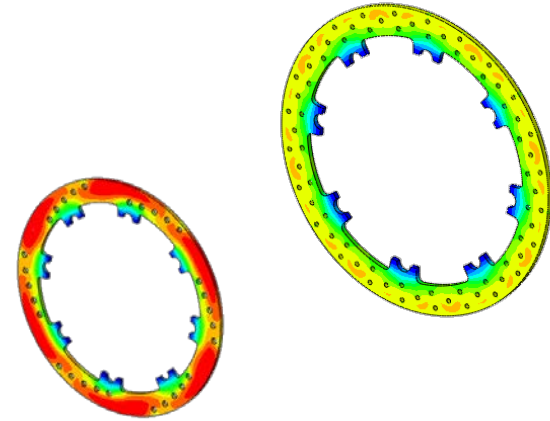
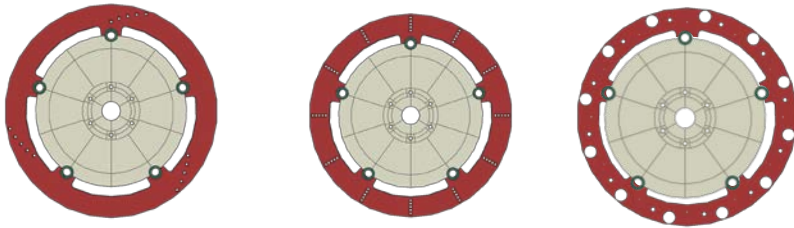
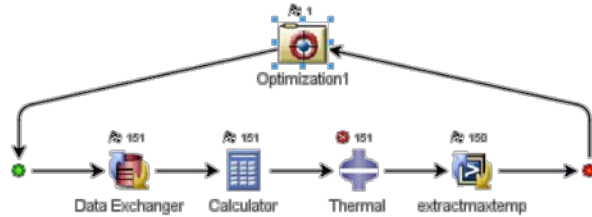
# Process to Accelerate Innovation



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# Parametric Optimization of the Disc for Efficient Cooling

- ▶ Avoid brake fade – efficient cooling
- ▶ Automatic generation and evaluation
- ▶ Best from hundreds of designs

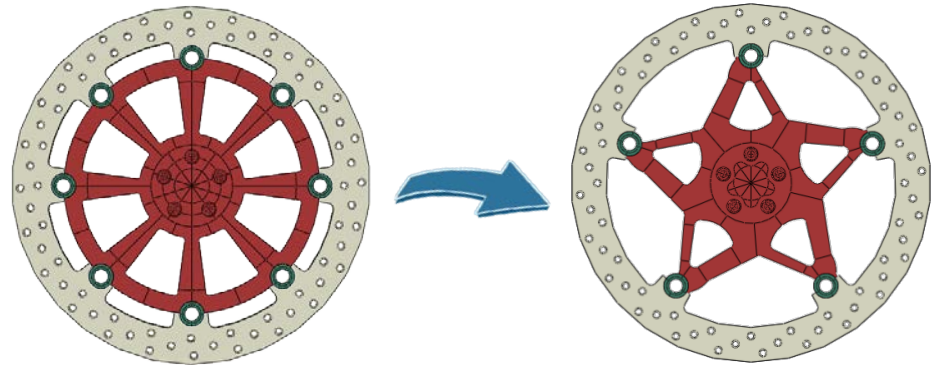


Maximum temperature of the disc was reduced by 30°C, while leaving sufficient surface area for efficient braking

# Topology Optimization of Carrier for Weight Reduction

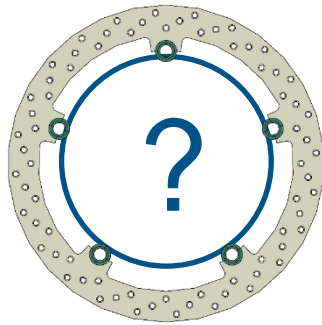
## Lightweight Conceptual Design

- ▶ Better performance at high speed
  - ▶ Sustaining severe brake loads
  - ▶ Stiff but lightweight design
- 
- ▶ Large scale modifications
  - ▶ Insured manufacturability
  - ▶ Non-linear modelling, contact

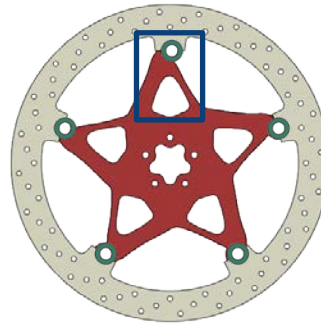


Weight of the carrier was reduced by 30%,  
while stiffness was doubled

# From Conceptual Design to Detailed Design

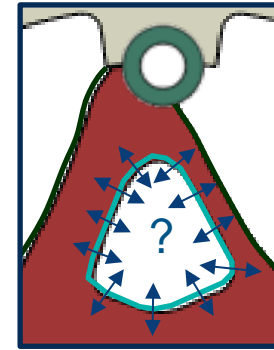


Design Space



Design Concept

light & stiff

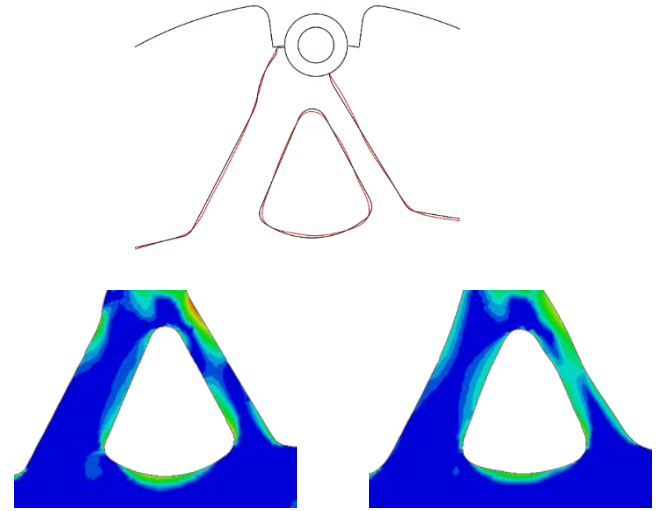
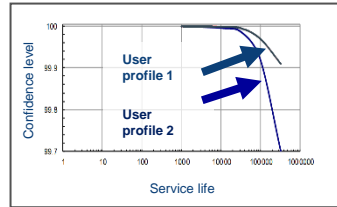
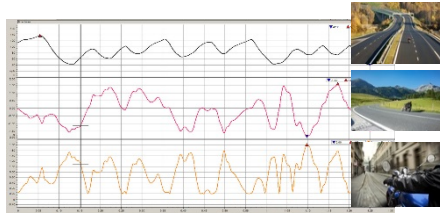


Detailed Design

durable

# Shape Optimization of Carrier for Improved Durability

- ▶ Insure longer product life
- ▶ Minimal design changes
- ▶ Precise surface shape
- ▶ Direct input from fatigue analysis



Initial design

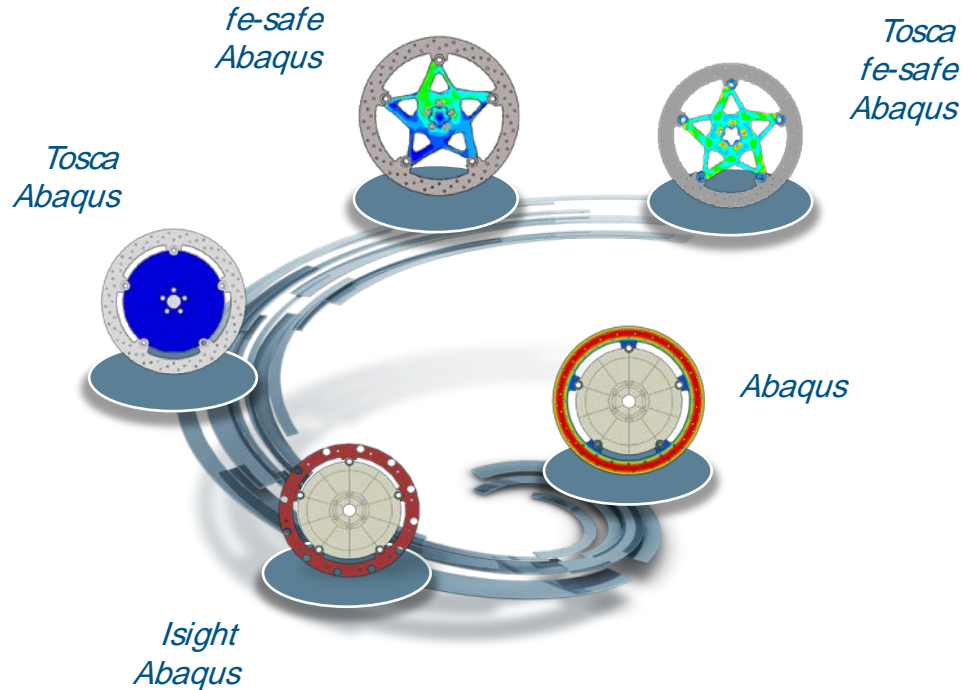
Optimized design

Life of carrier was increased  
more than 3 times



# Process to Accelerate Innovation

Consistent use of optimization enables design innovation from concept till detail



All simulation technologies used in this workflow are available in SIMULIA Portfolio



*Leverage the potential of optimization to  
accelerate innovation !*