

Electric Drive Noise & Vibration Analysis



3DEXPERIENCE®

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Disclosure

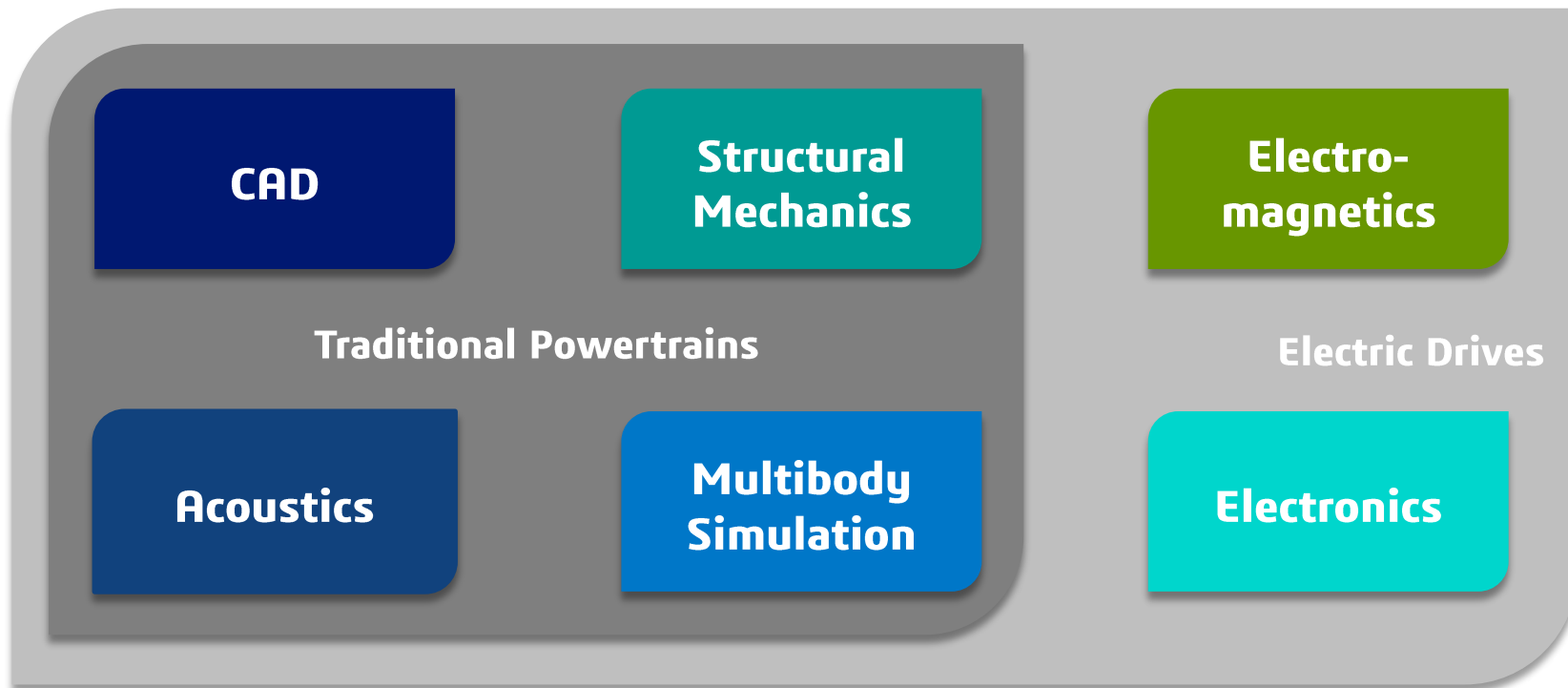
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Electric Drive N&V Analysis



Electric Drive N&V Analysis

CAD

CATIA

**Structural
Mechanics**

Abaqus

**Electro-
magnetics**

CST

Acoustics

Wave6

**Multibody
Simulation**

Simpack

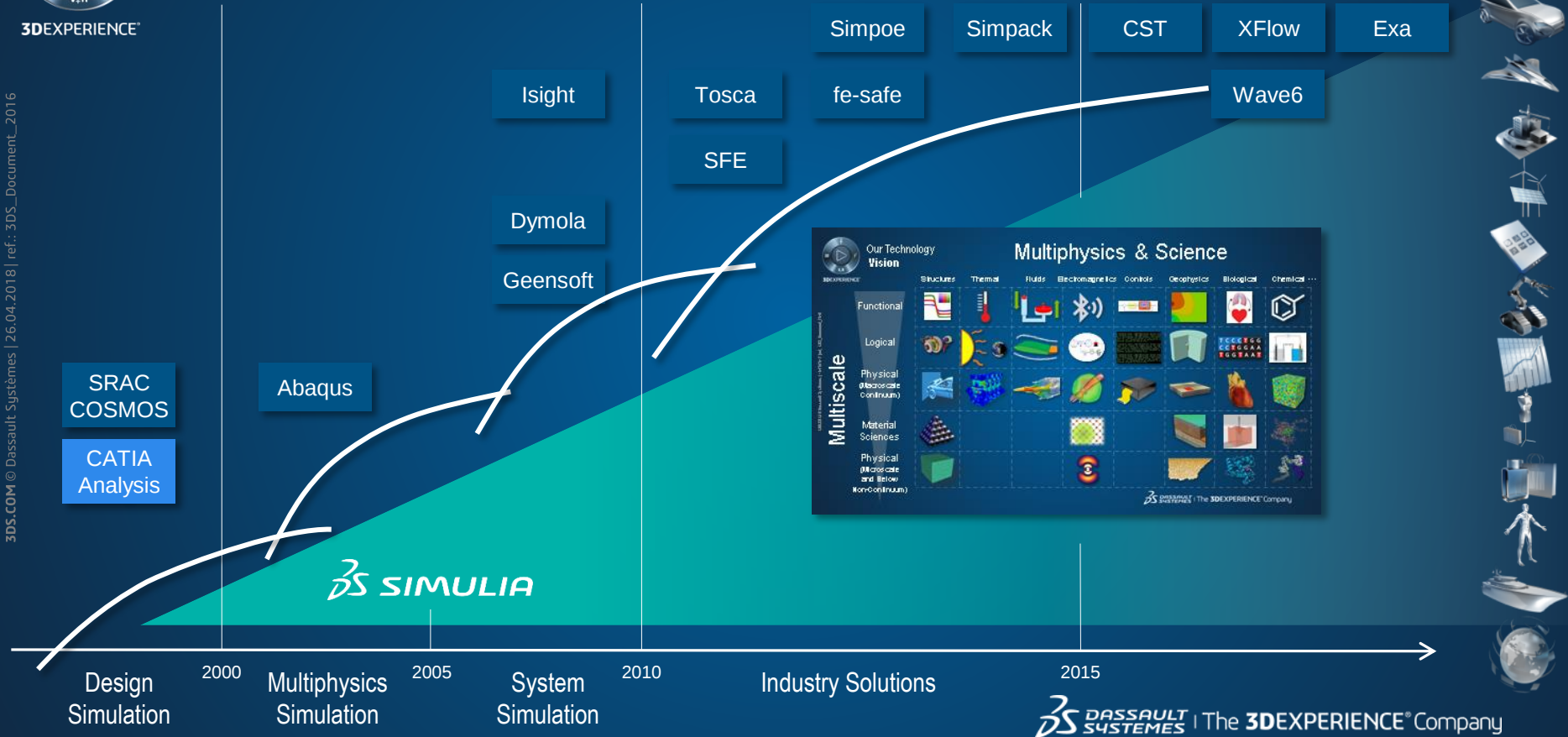
Electronics

Dymola

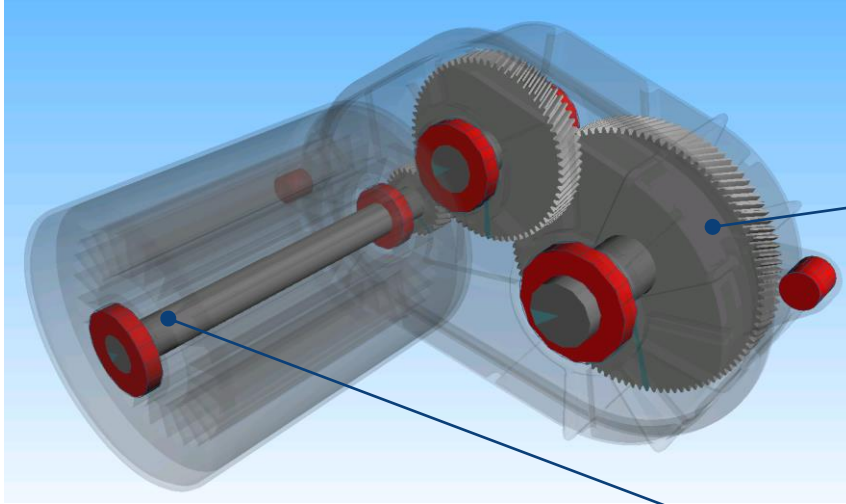


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Dassault Systèmes Long-term Commitment to Simulation



Typical Electric Drive Topology



Gearbox

1-speed gearbox / multi-speed gearbox

Two-stage helical gears / planetary gears

Differential included

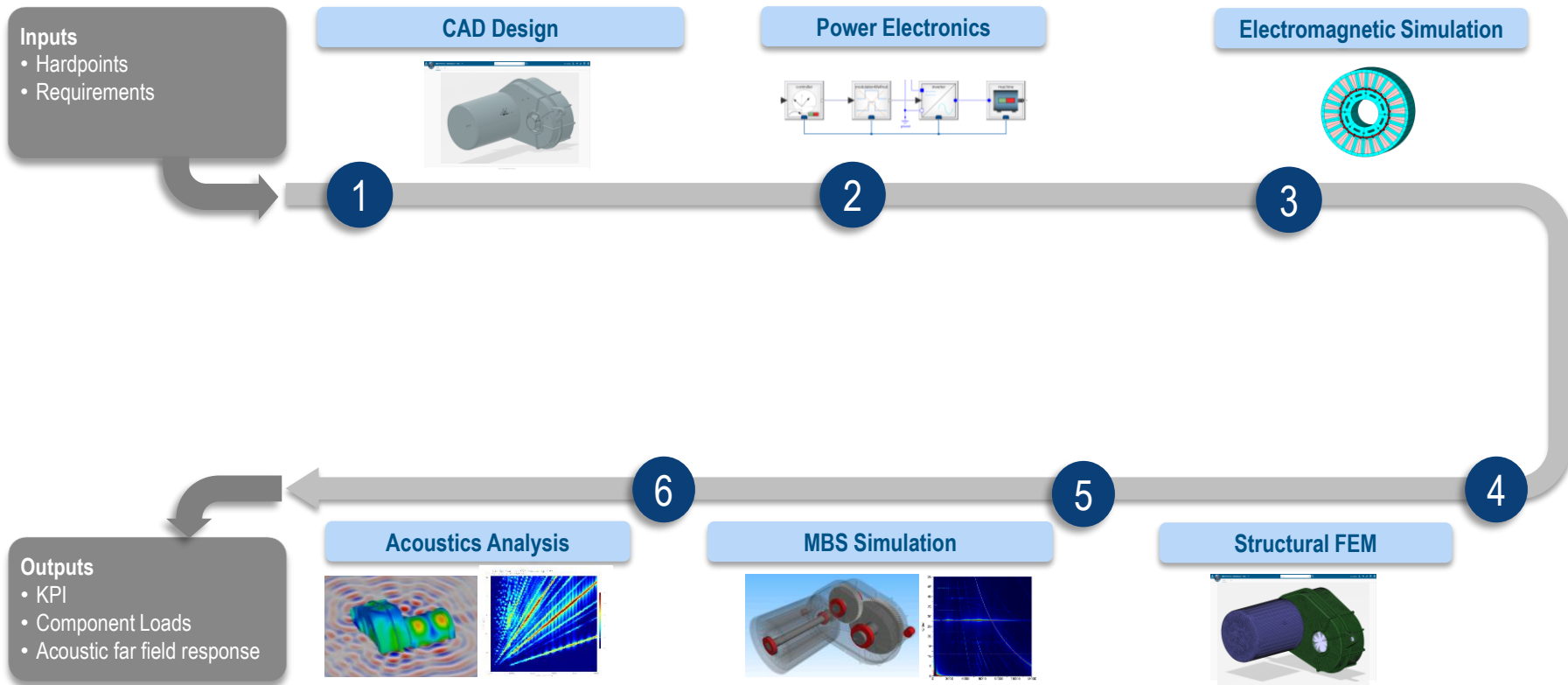
Lightweight structure and compact design

Electric Motor

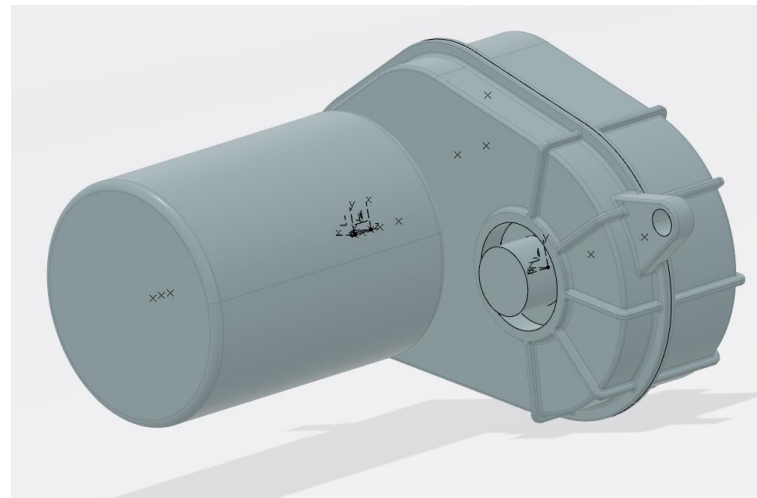
Permanent magnet synchronous machine

High rotational speeds up to 20 000 rpm

Electric Drive N&V Analysis

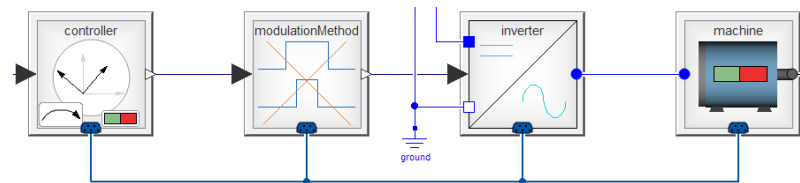
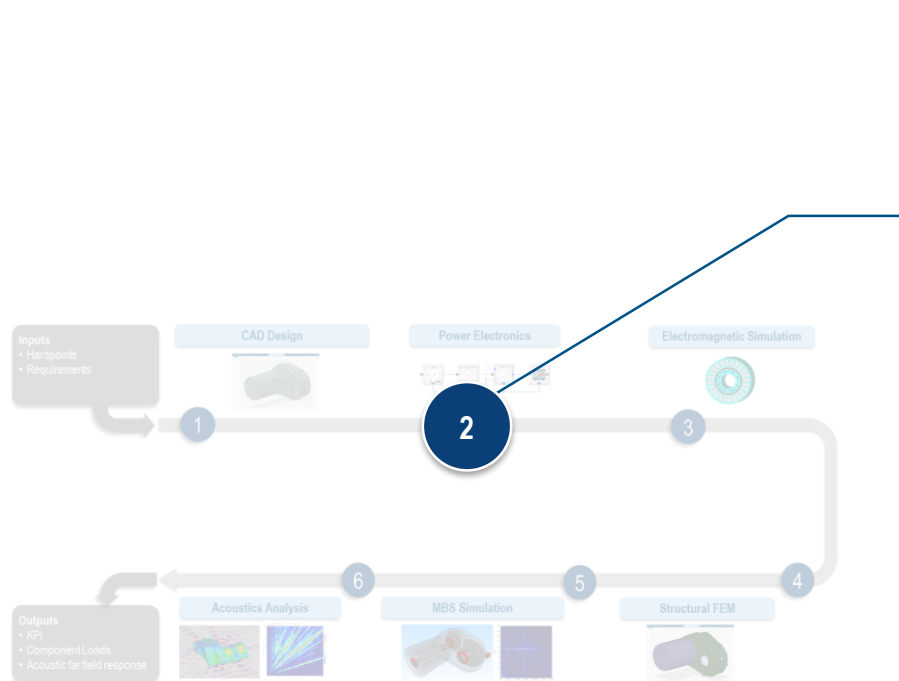


Electric Drive N&V Analysis



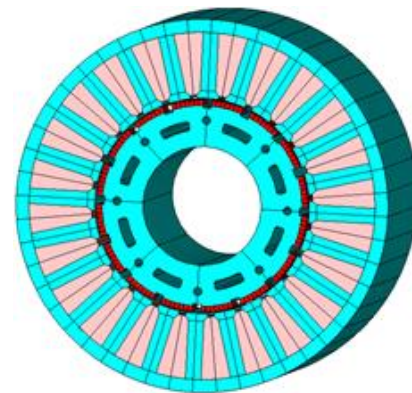
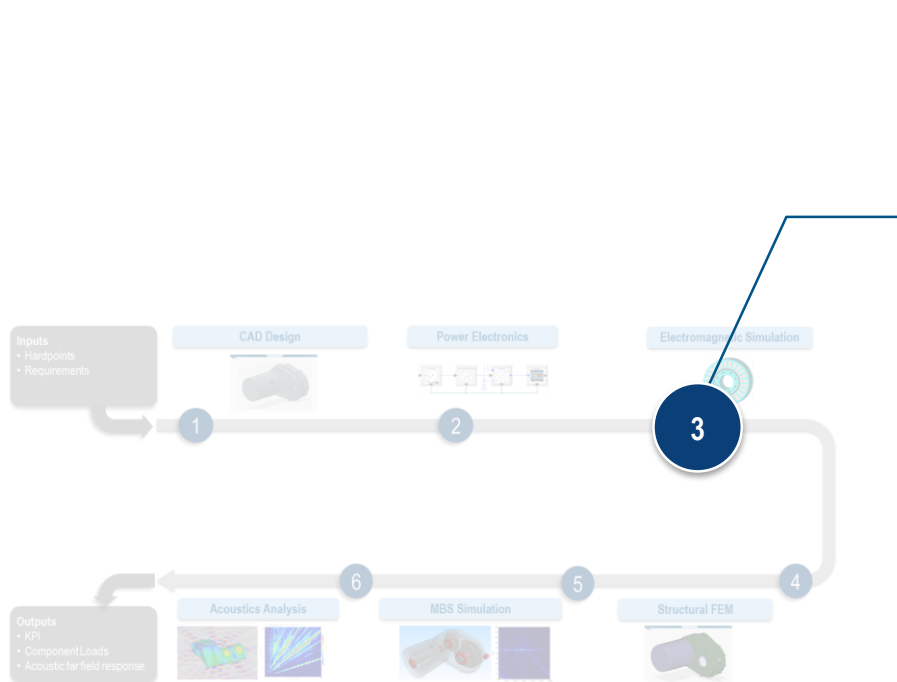
CAD Design

Electric Drive N&V Analysis



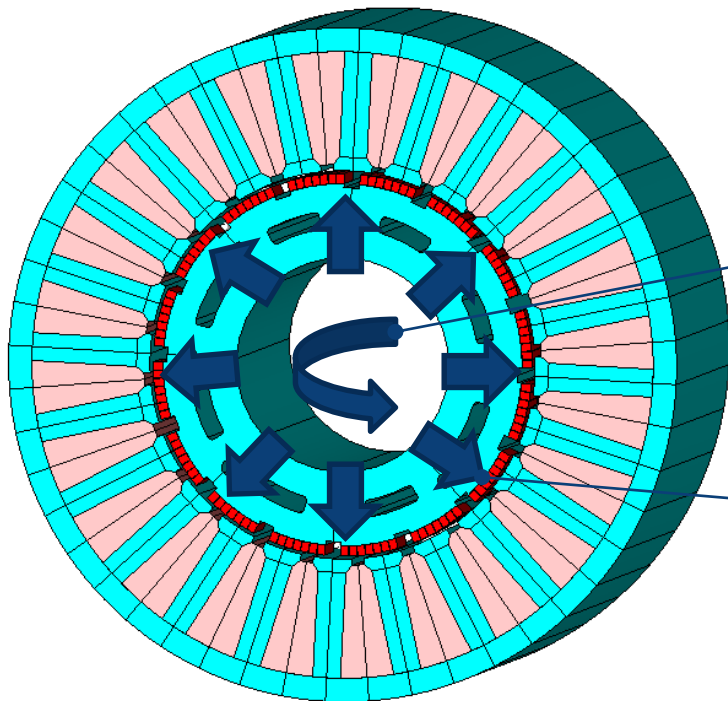
Power Electronics

Electric Drive N&V Analysis



Electromagnetic Simulation

Vibration sources



Electromagnetic Torque

Torque ripple

Harmonic excitation

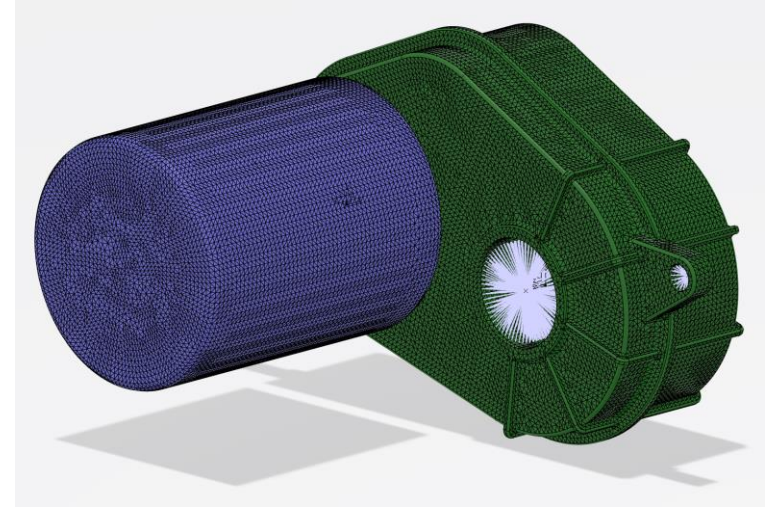
Transferred through the rotor shaft

Radial Electromagnetic Forces

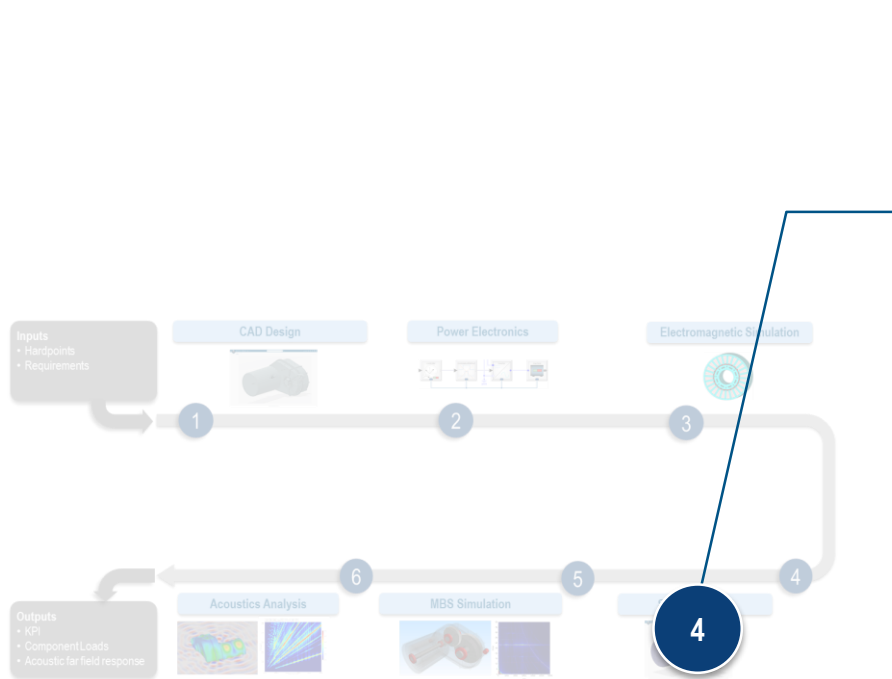
Forces acting on the stator package

Harmonic excitation

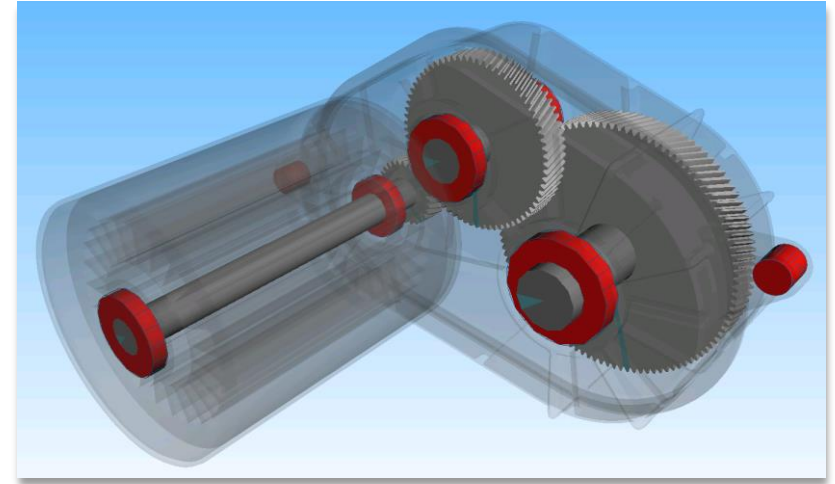
Electric Drive N&V Analysis



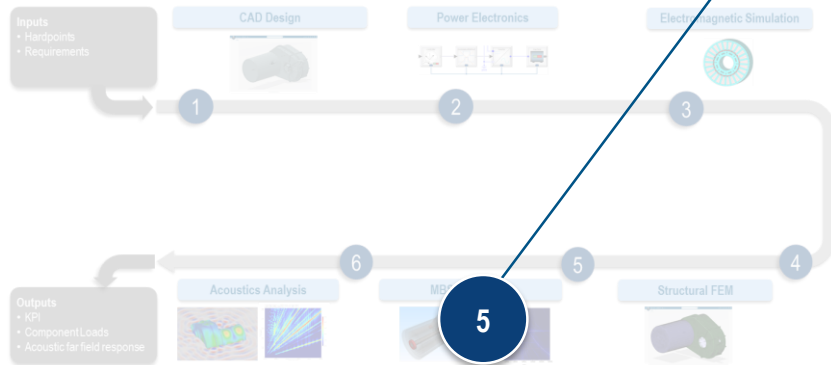
FEA Substructure Generation



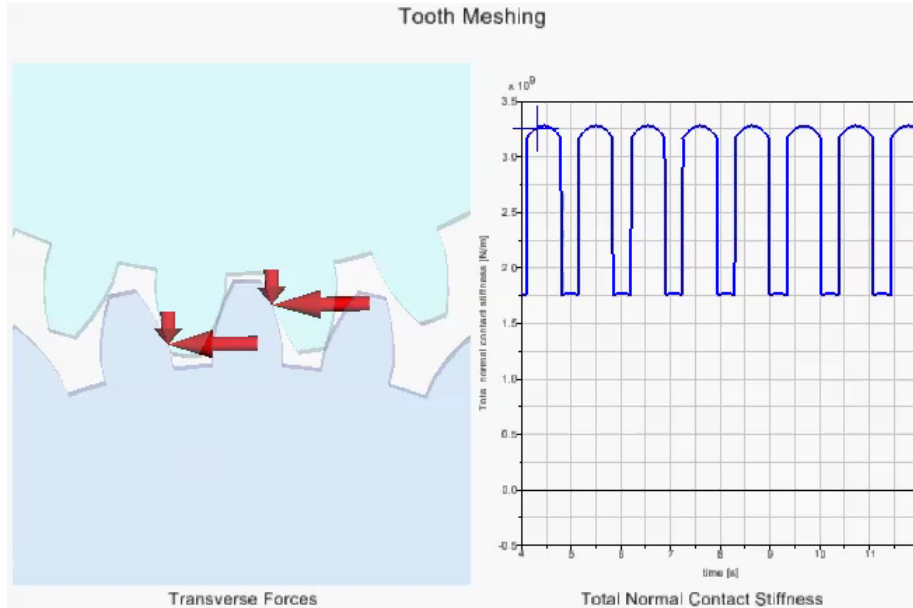
Electric Drive N&V Analysis



Multibody Simulation



Vibration sources



Gear contact

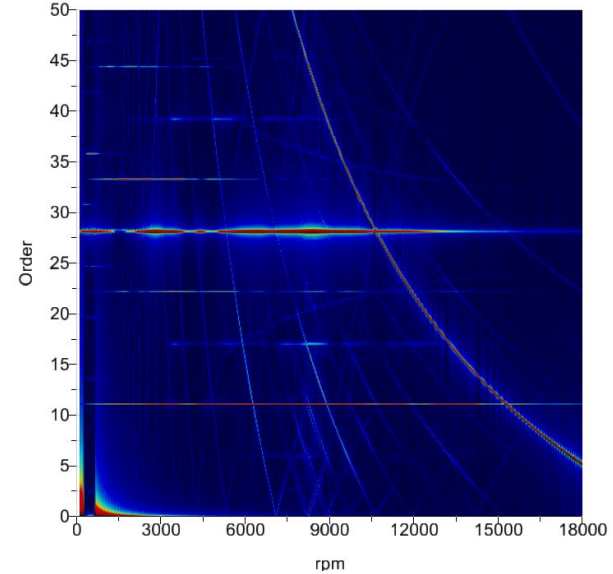
Alternating number of teeth in contact

Stiffness variation causes transmission error

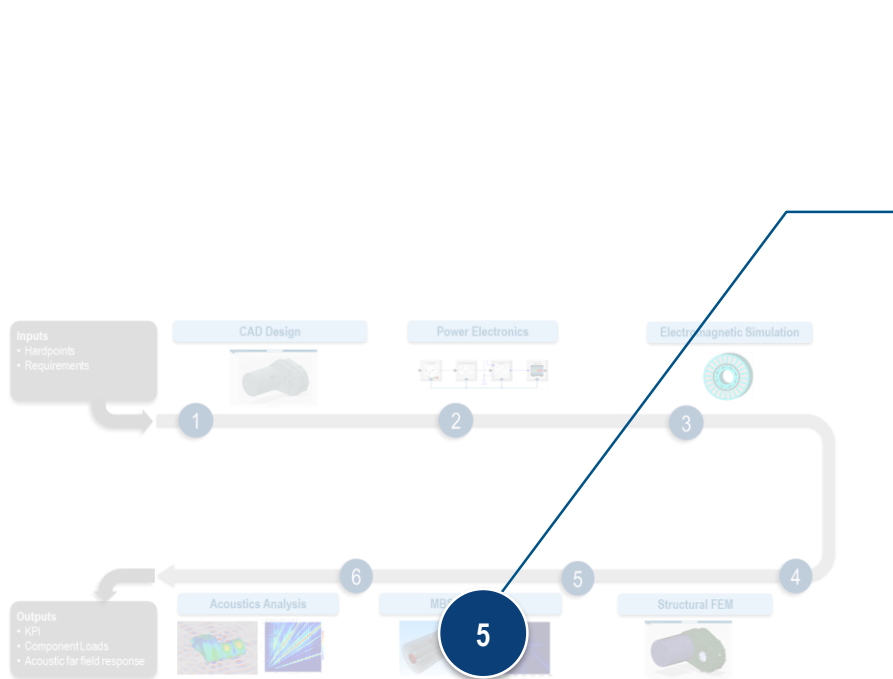
Torsional, radial and axial excitation due to helical gears

Lightweight structure and design

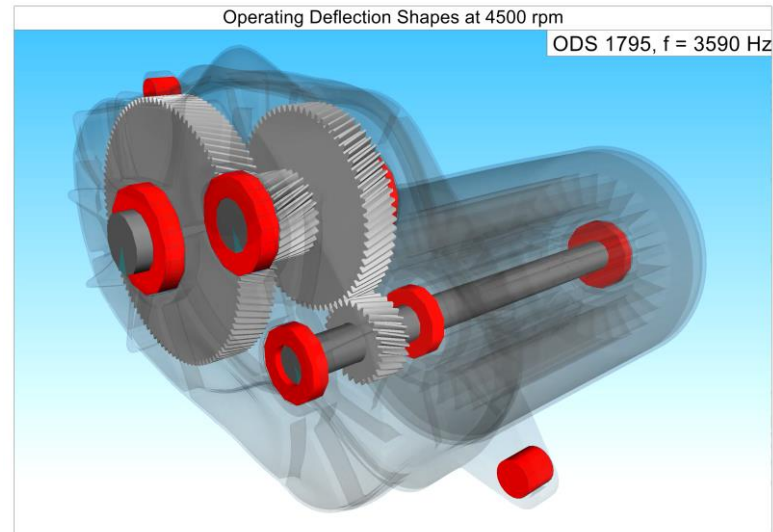
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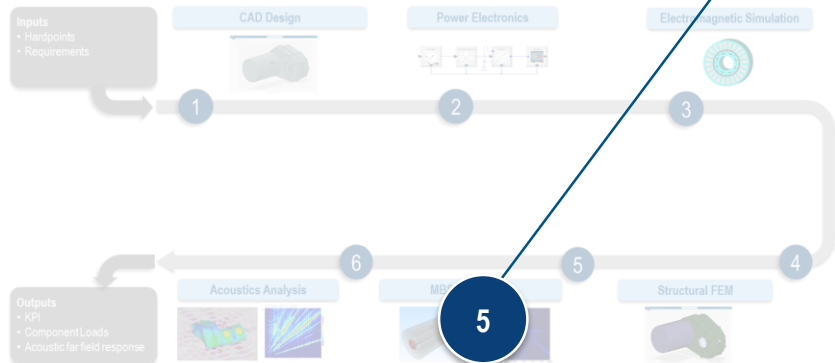
Multibody Simulation



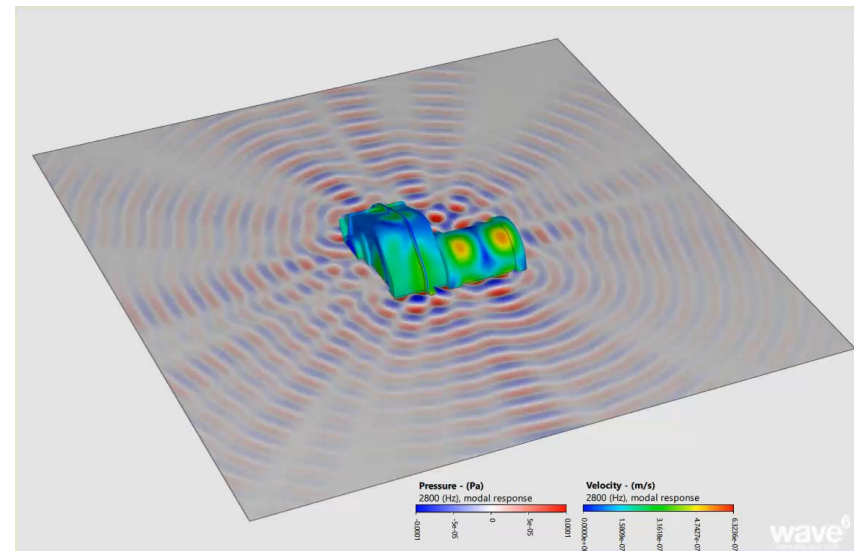
Electric Drive N&V Analysis



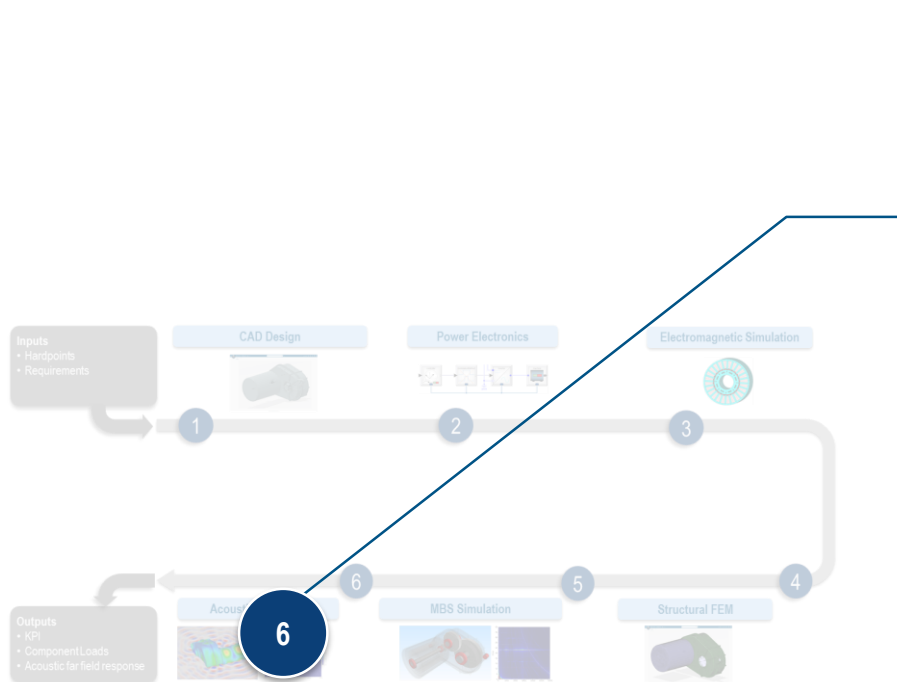
Multibody Simulation



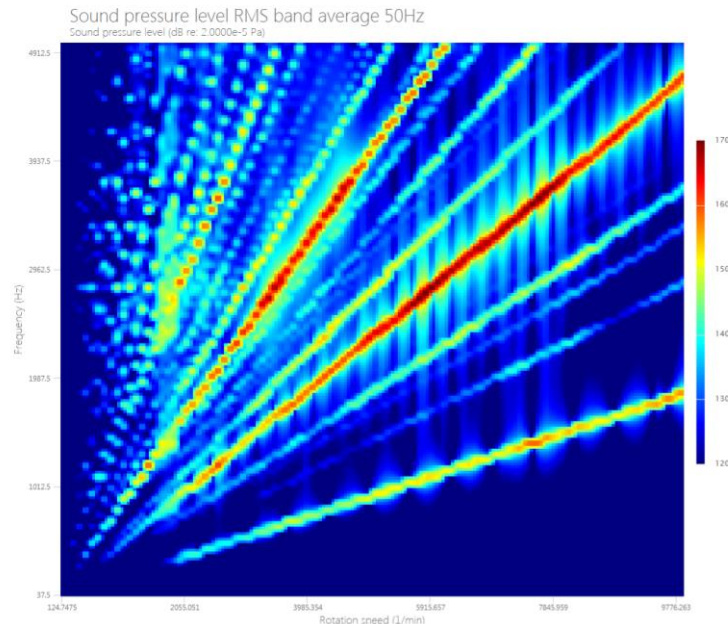
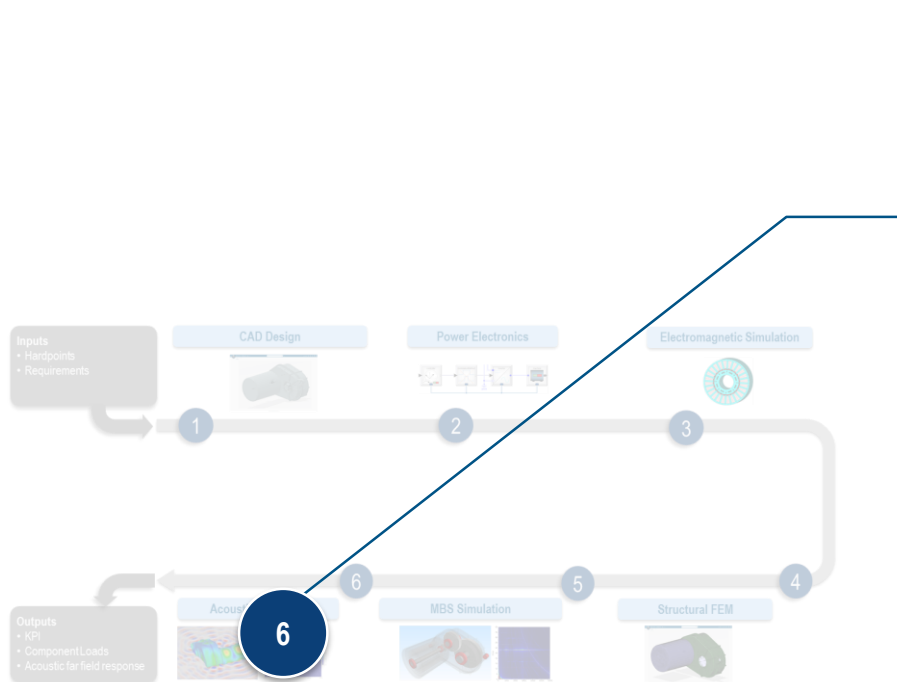
Electric Drive N&V Analysis



Acoustics Simulation

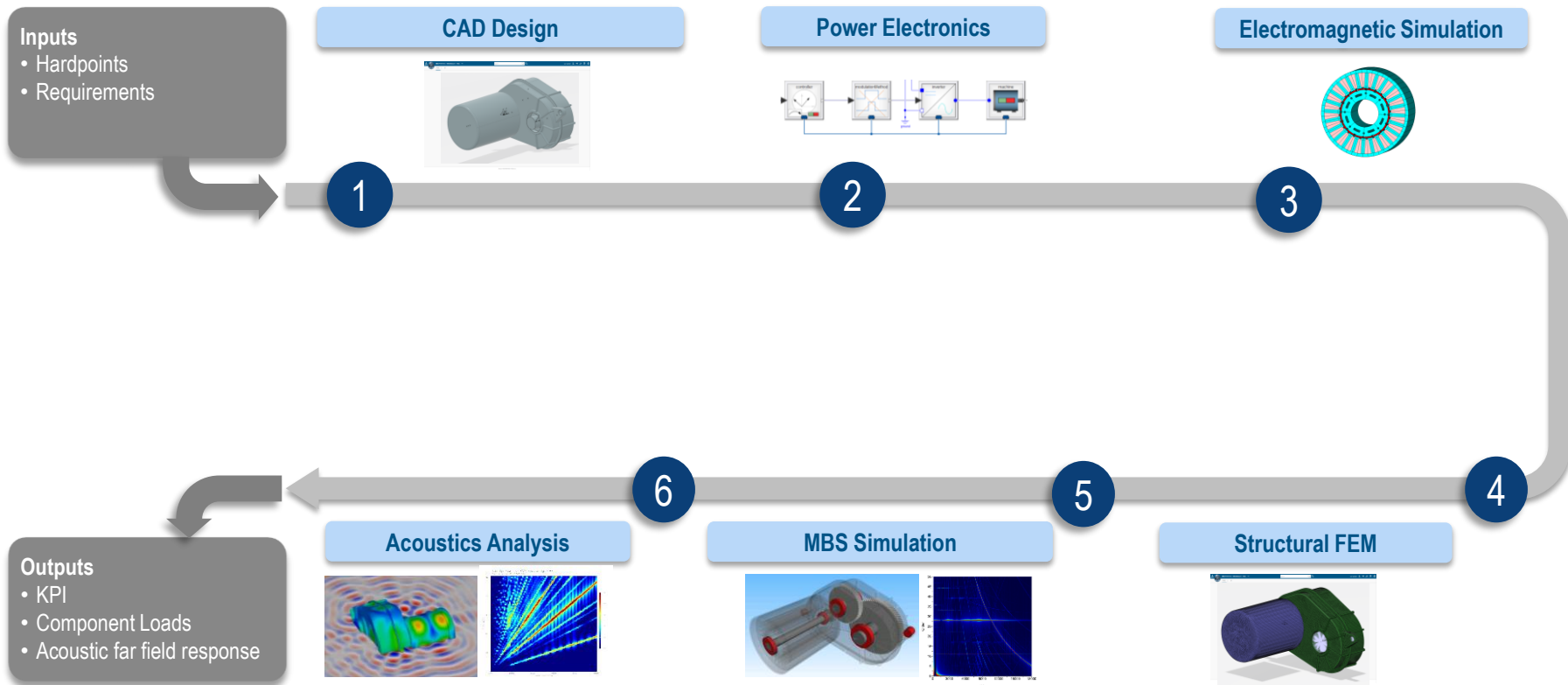


Electric Drive N&V Analysis



Acoustics Simulation

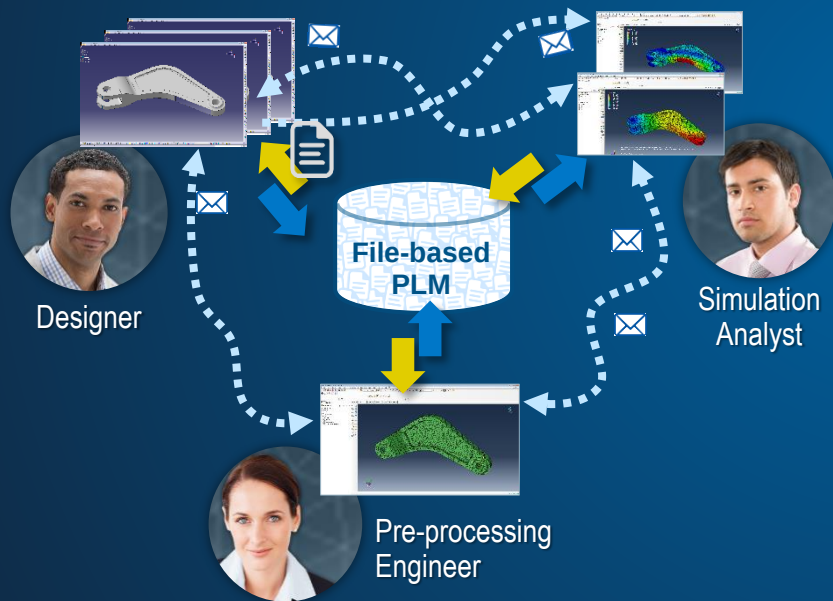
Electric Drive N&V Analysis



Digital acceleration – 16 hours to <1 hour

From file-based... **ELECTRONIC**

Time required to find optimum design **16 hours**



to **3DEXPERIENCE** platform-based... **DIGITAL**

Time required to find optimum design **1 hour**

