

Optimization of the CFRP-boom of a sailing dinghy

11. Weimarer Optimierungs- und Stochastiktage

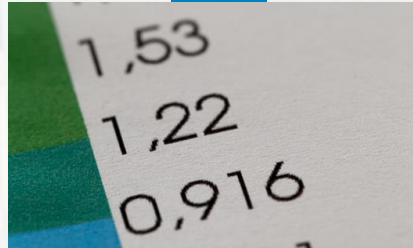
Our Clients



Planning and
conception



Design and
development



Calculation and
simulation



Implementation



Knowledge and experience
of our employees

Introduction:
Sailing, functions and requirements of a boom

Properties of composites:
Influence of the parameters

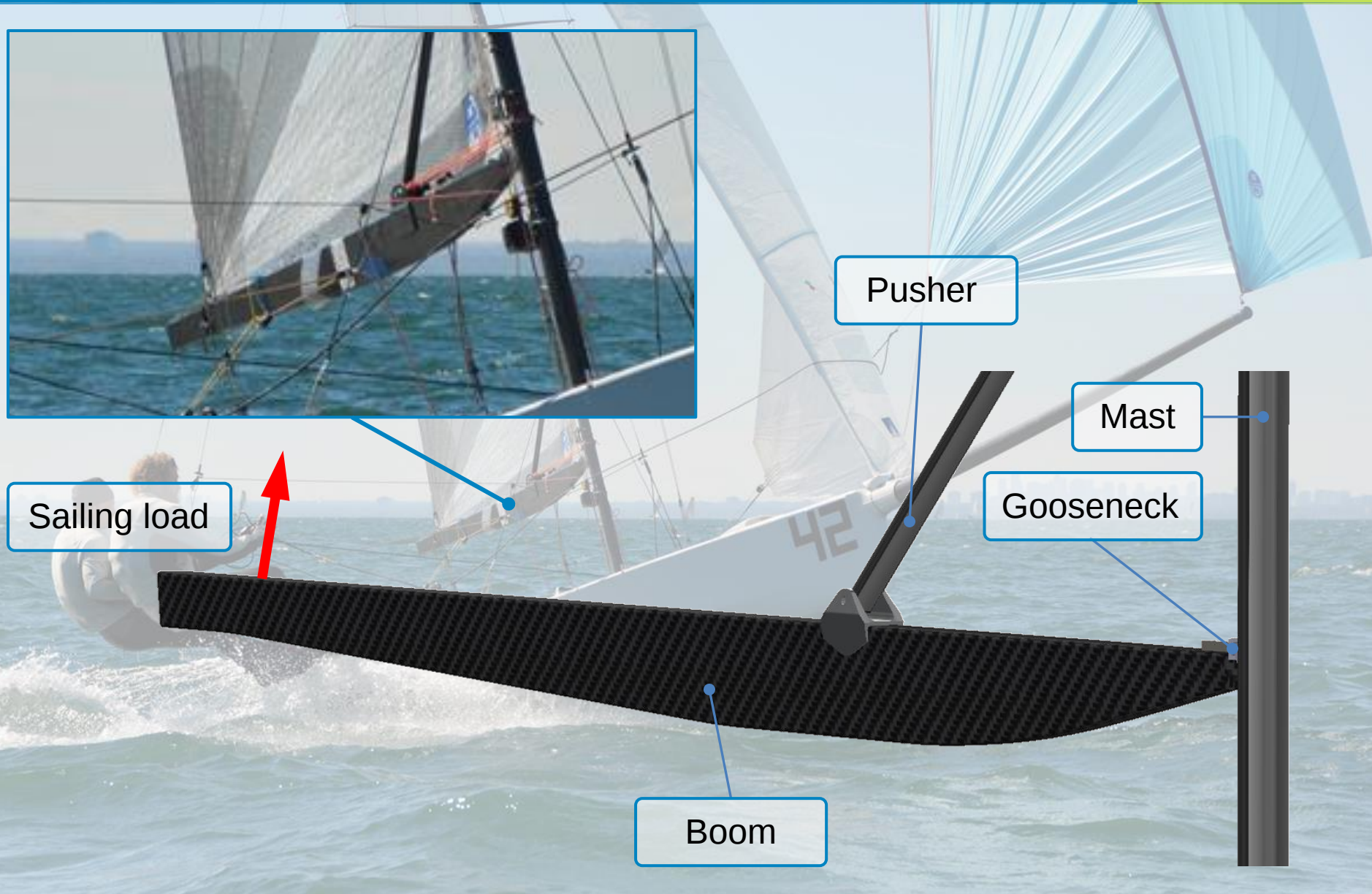
Design optimization with optiSlang:
Sensitivity analysis, optimization and robustness evaluation

Phases of a composite project:
Integration of the optimization

Boat class International 14



Boat class International 14



High stiffness

Low manufacturing and material costs

Low weight

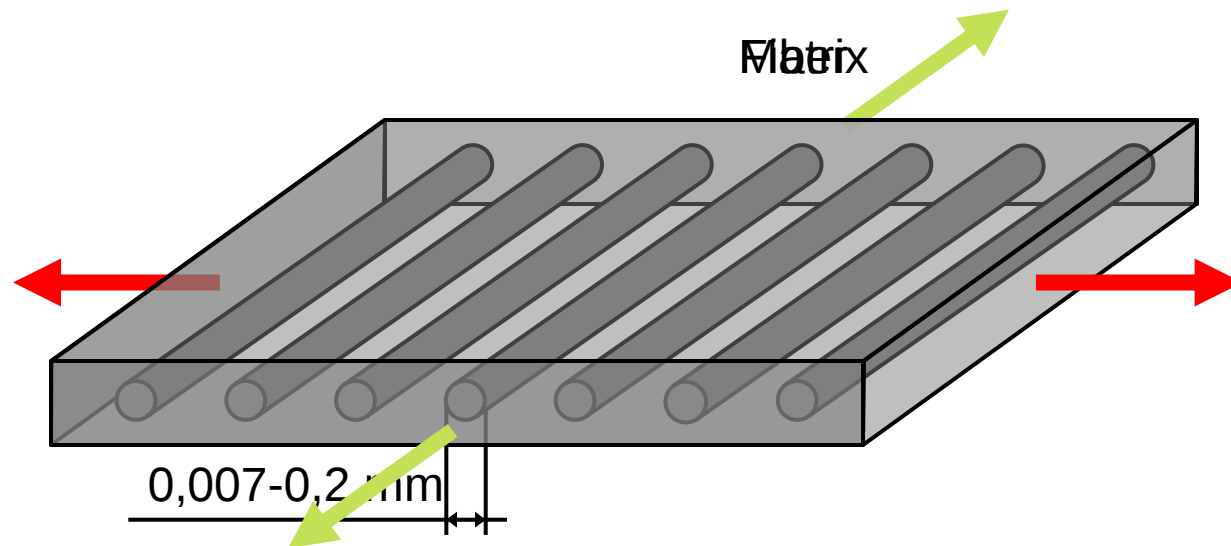
UV-resistant

Sufficient strength

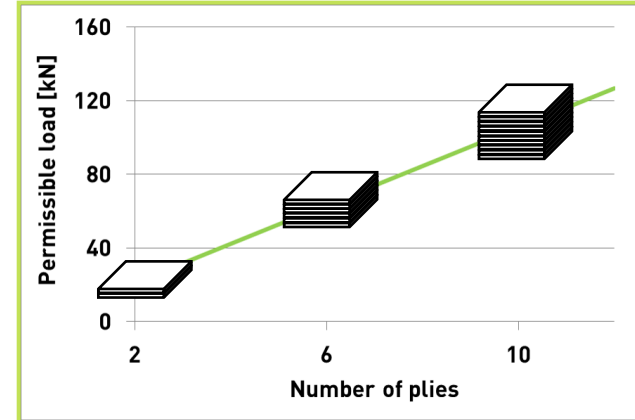
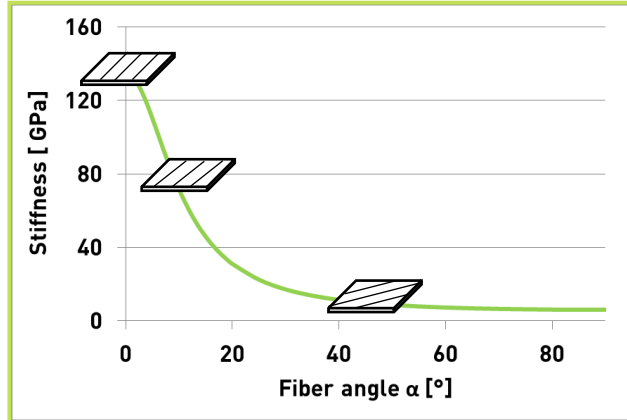
Resistant to sea water

Goal: Optimization of the composite





Material properties depend on the fiber angle

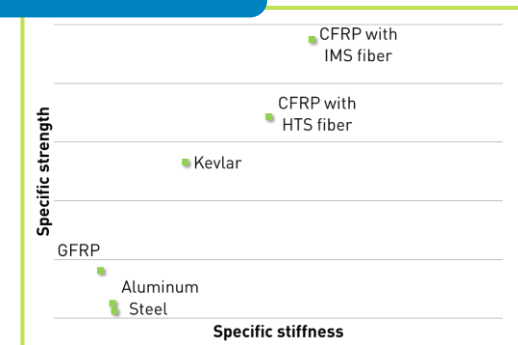
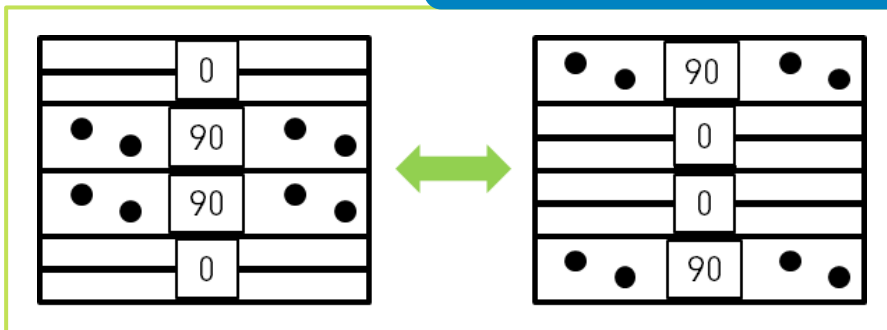


Fiber

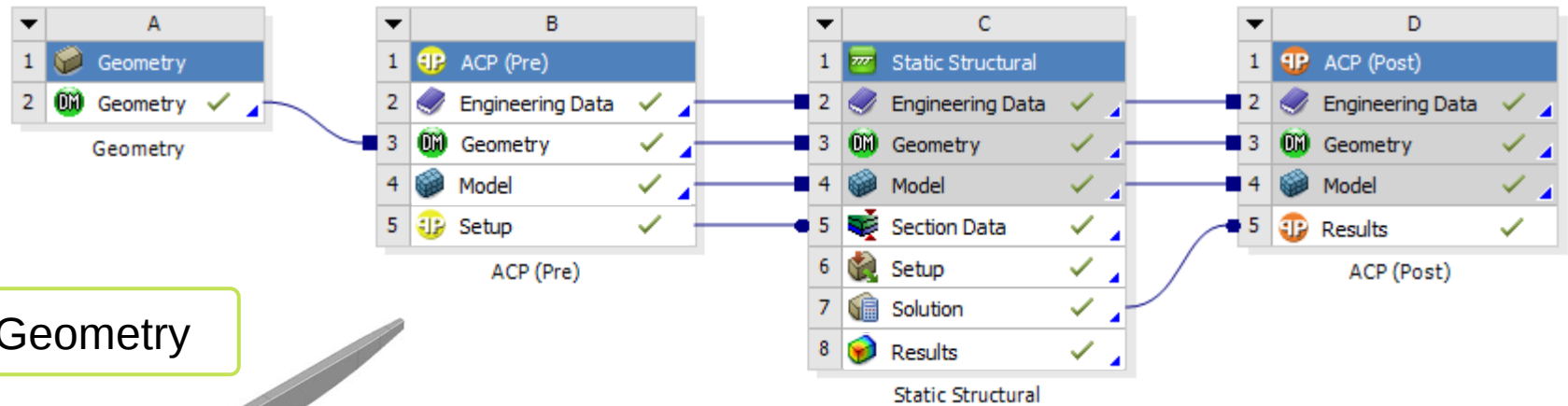
plies

Countless number of combinations possible

Stacking



Project progression in ANSYS Workbench



1: Geometry

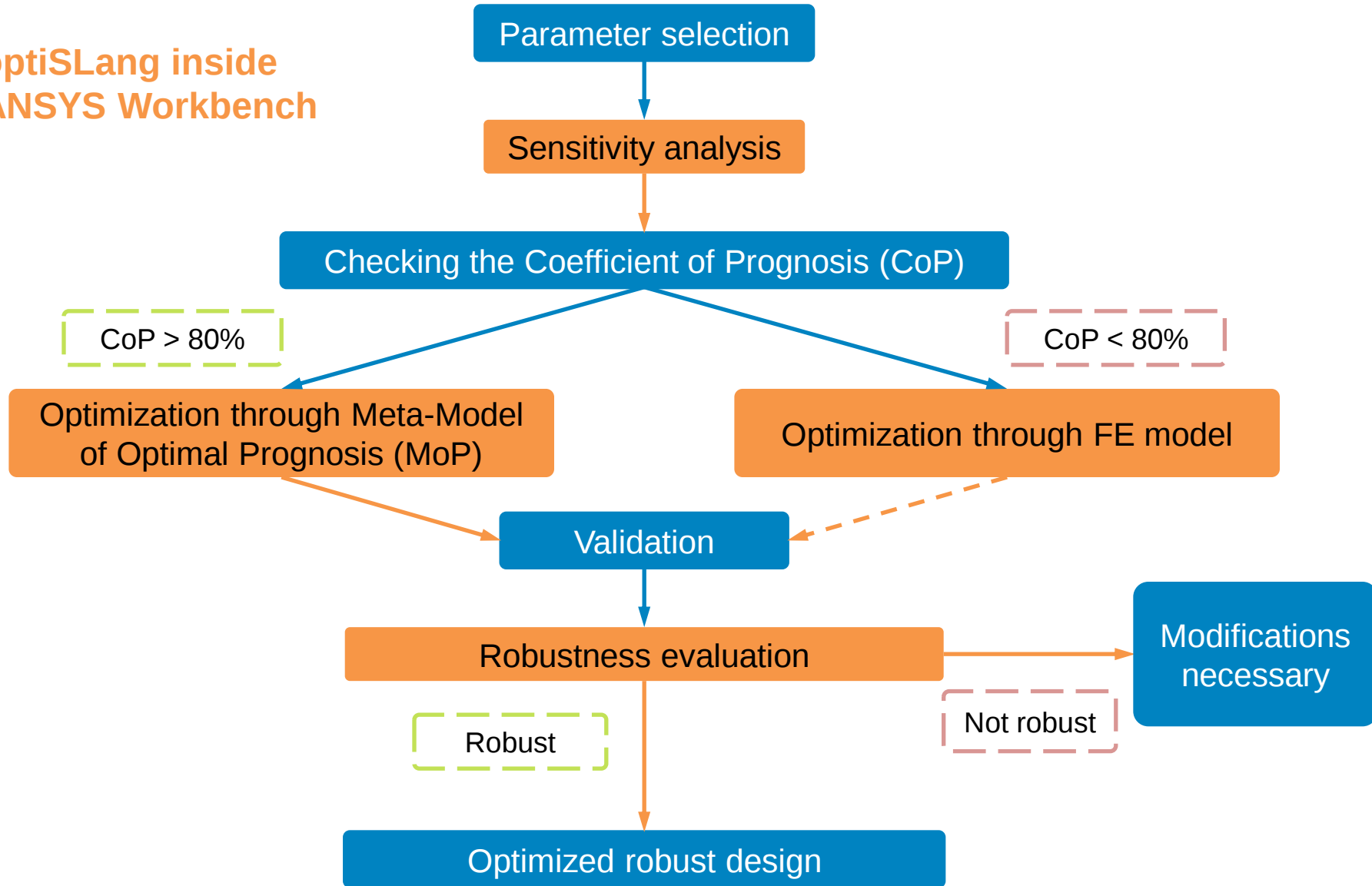
2: Meshing

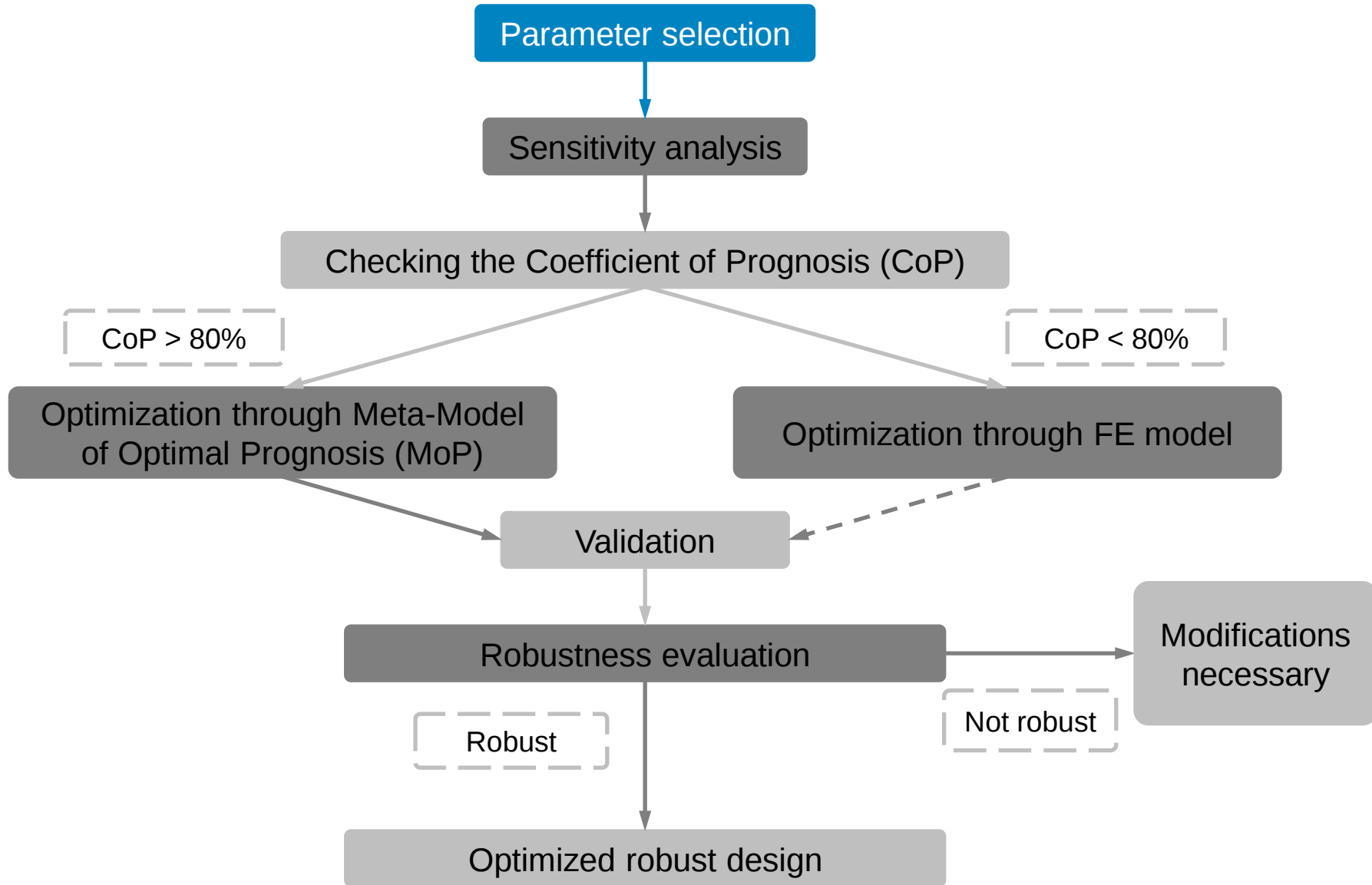
3: Laminate design

5: Results

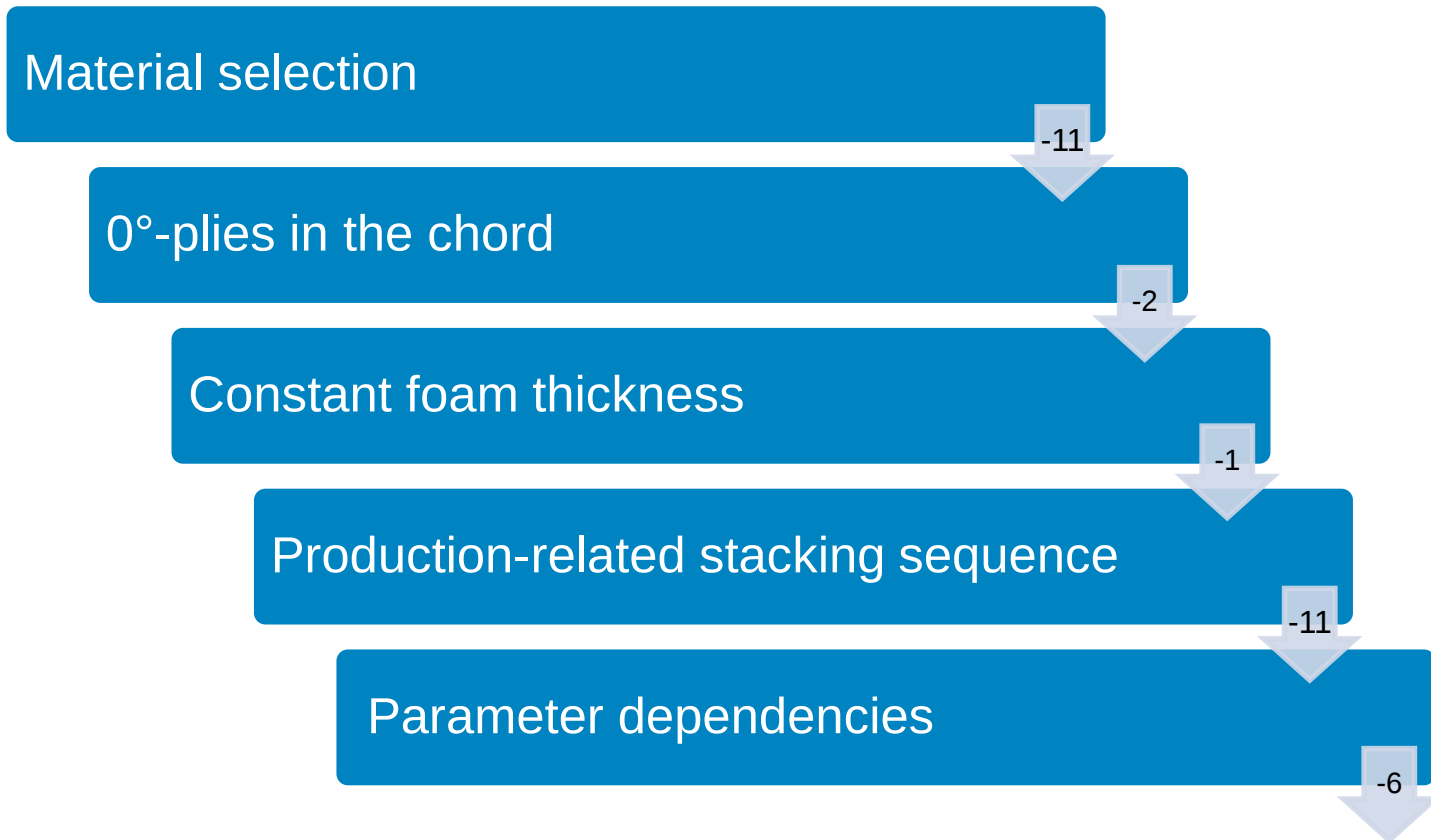
4: Load step

optiSLang inside
ANSYS Workbench

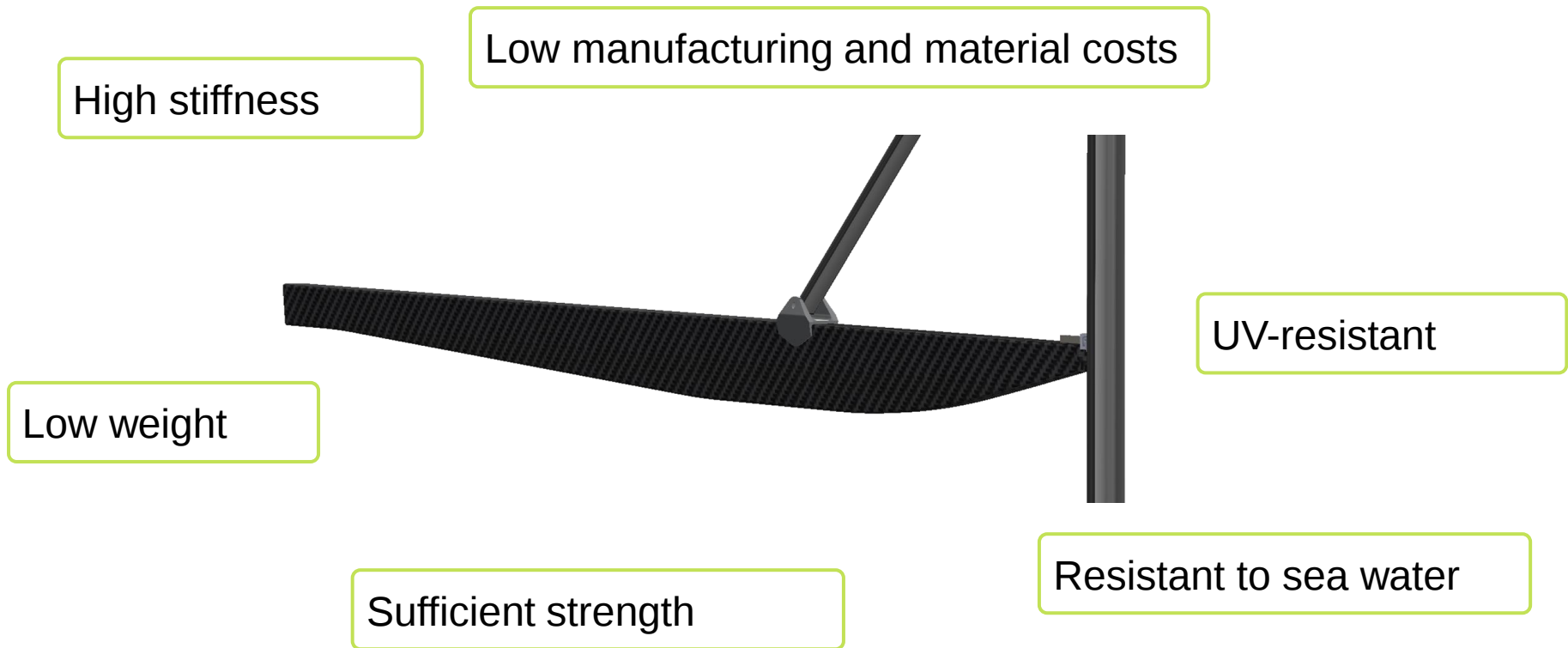


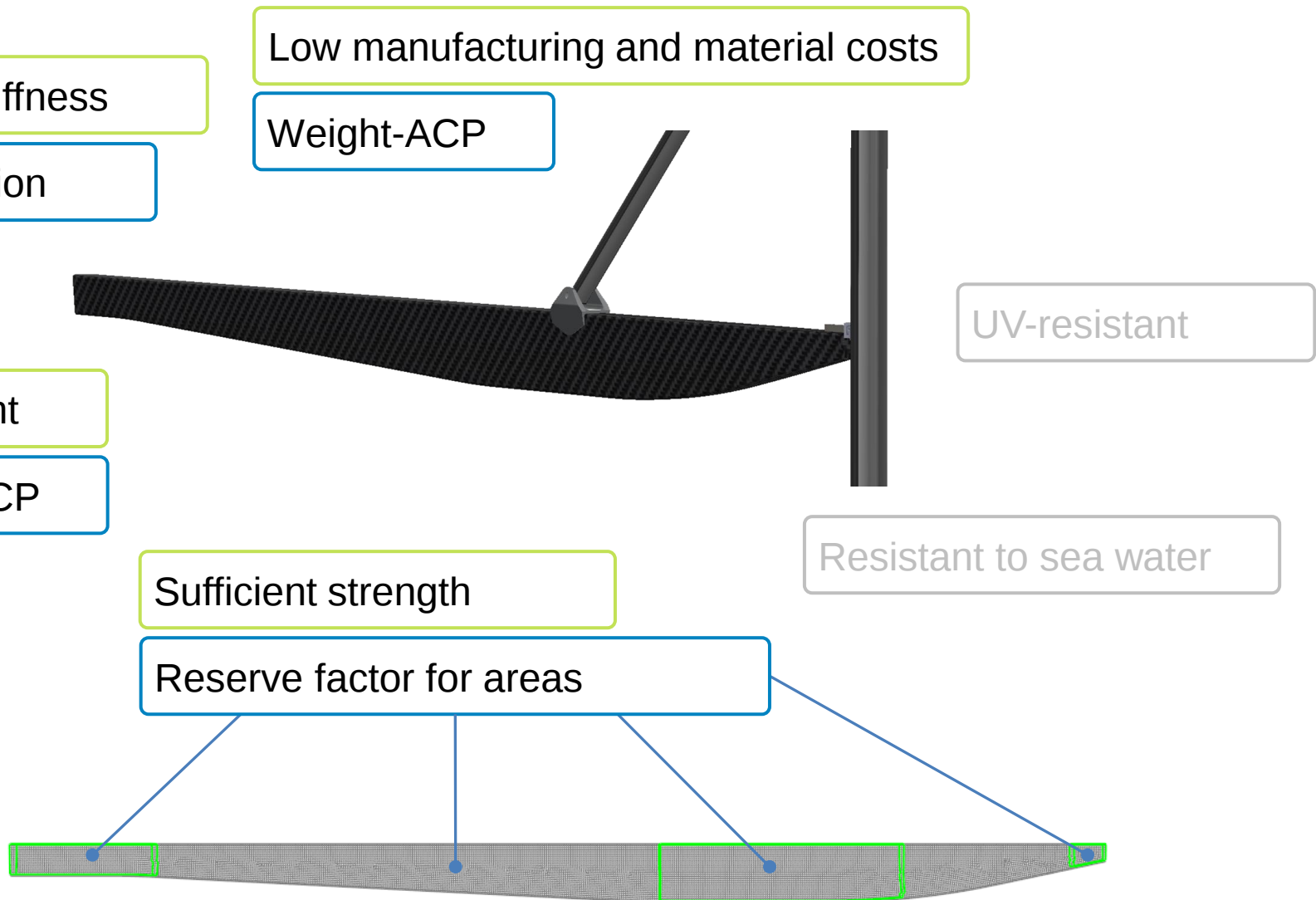


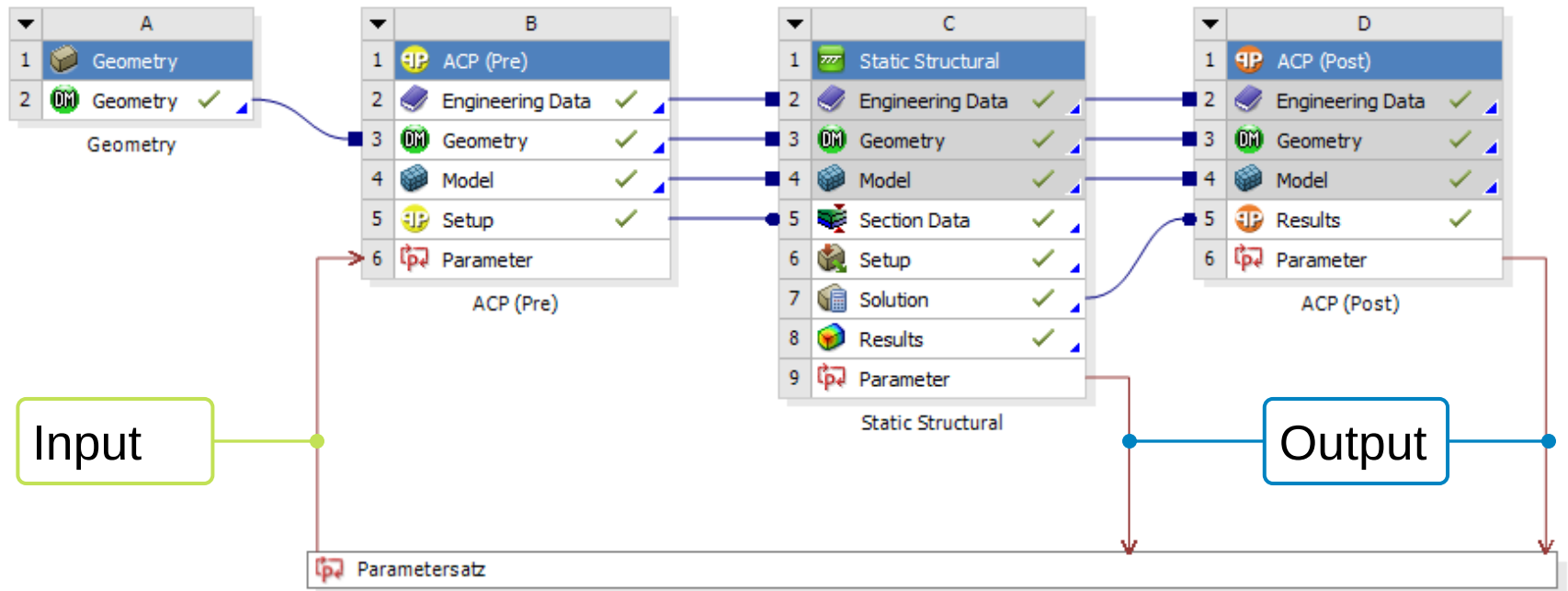
Before: 43 Input parameter



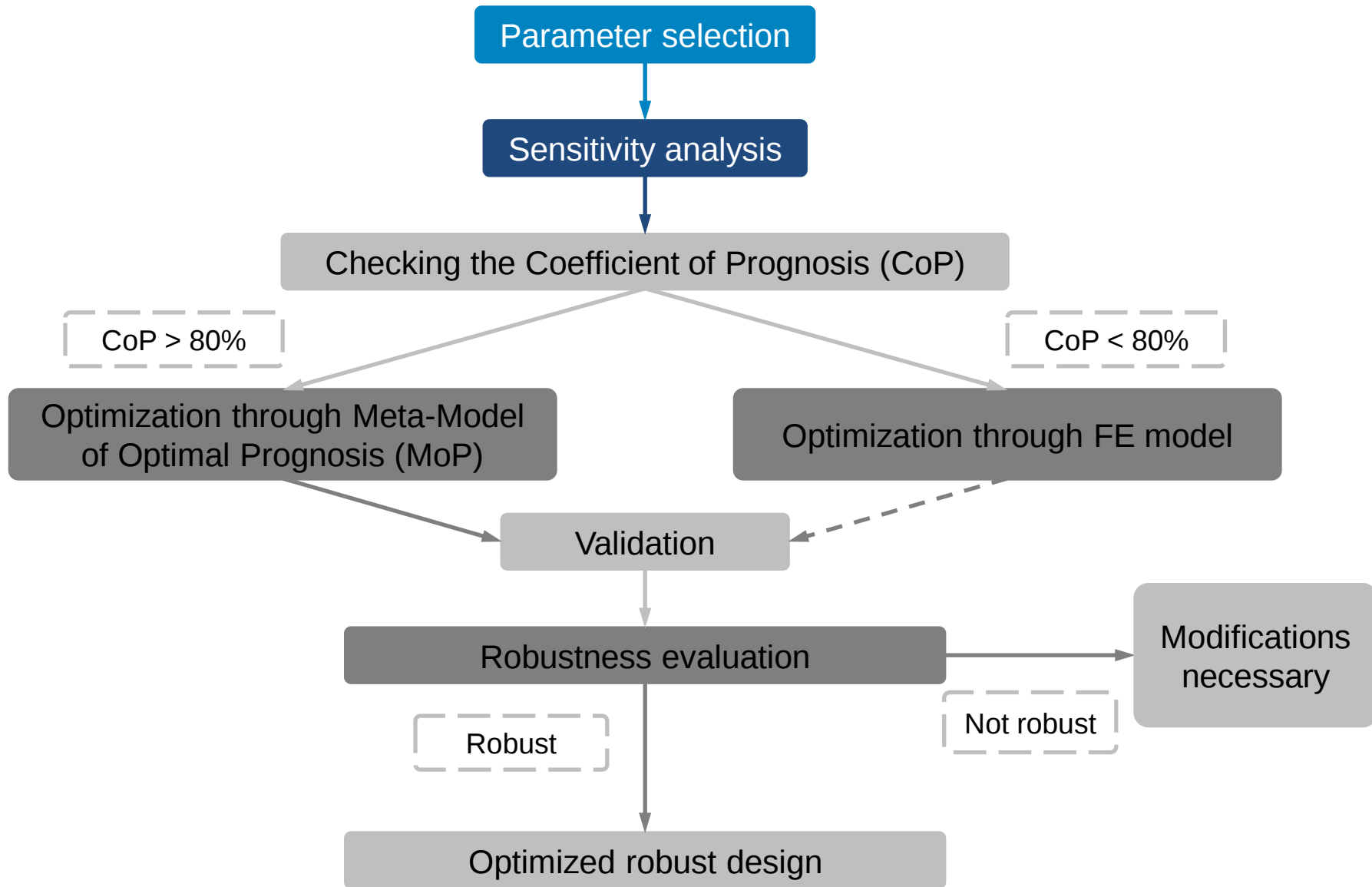
After: 12 Input parameter







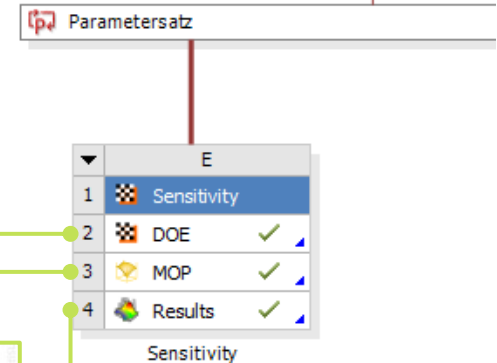
Parameter set controls project



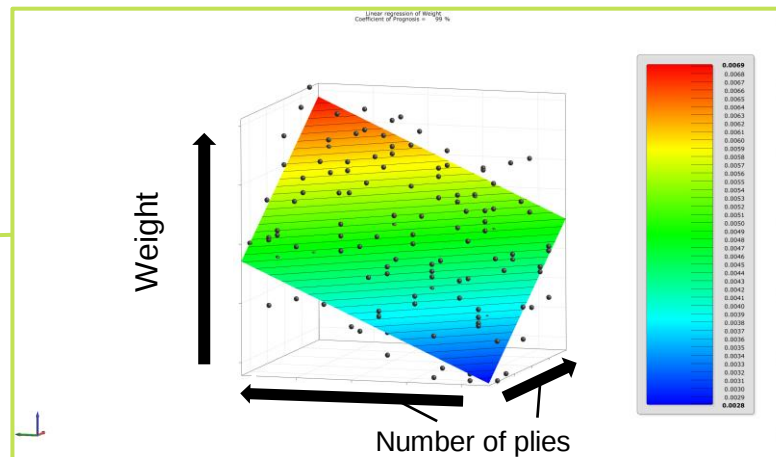
Goal: Get an indication of the sensitivity of the parameters

1: Design of Experiments

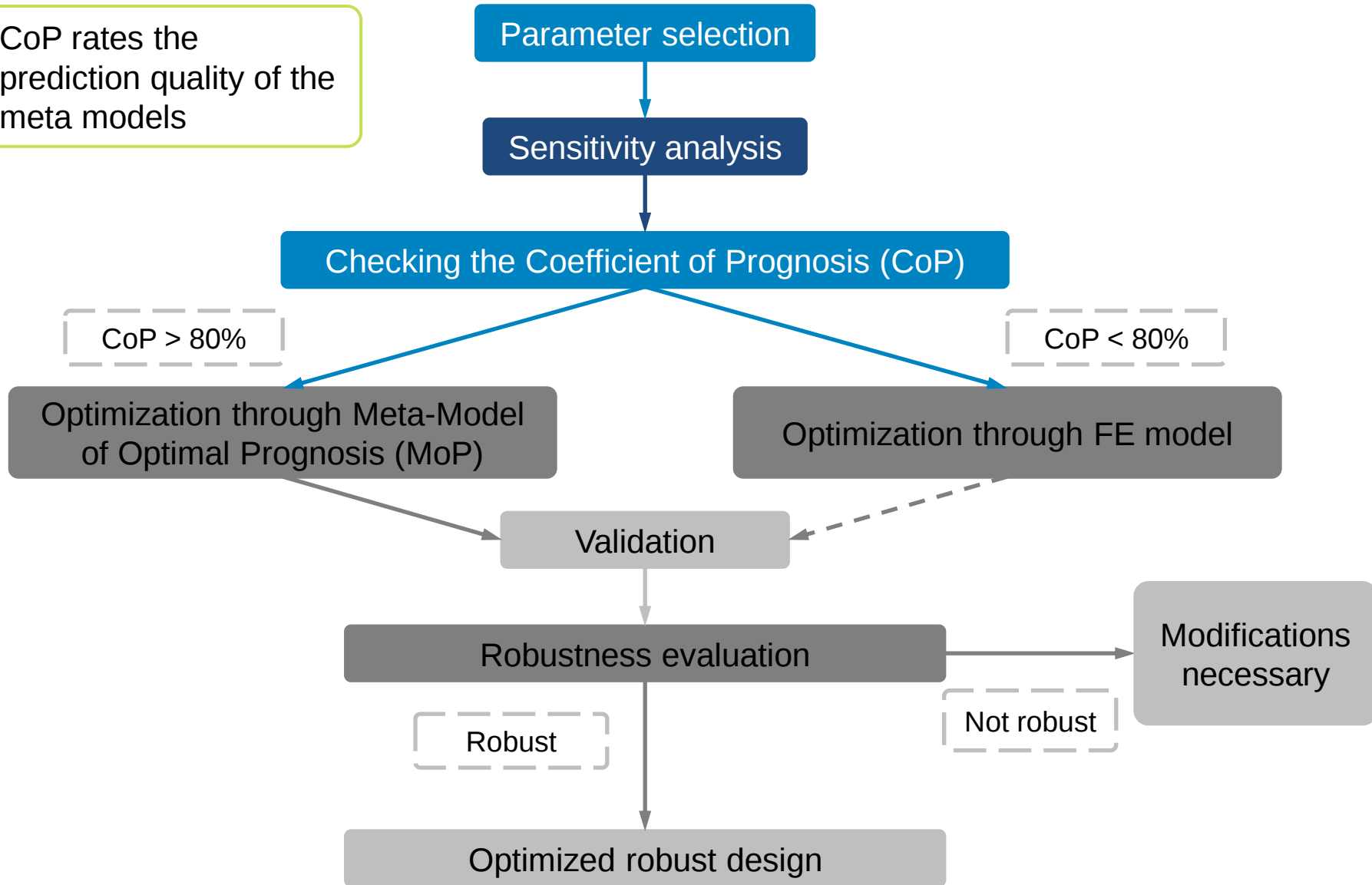
2: Related model



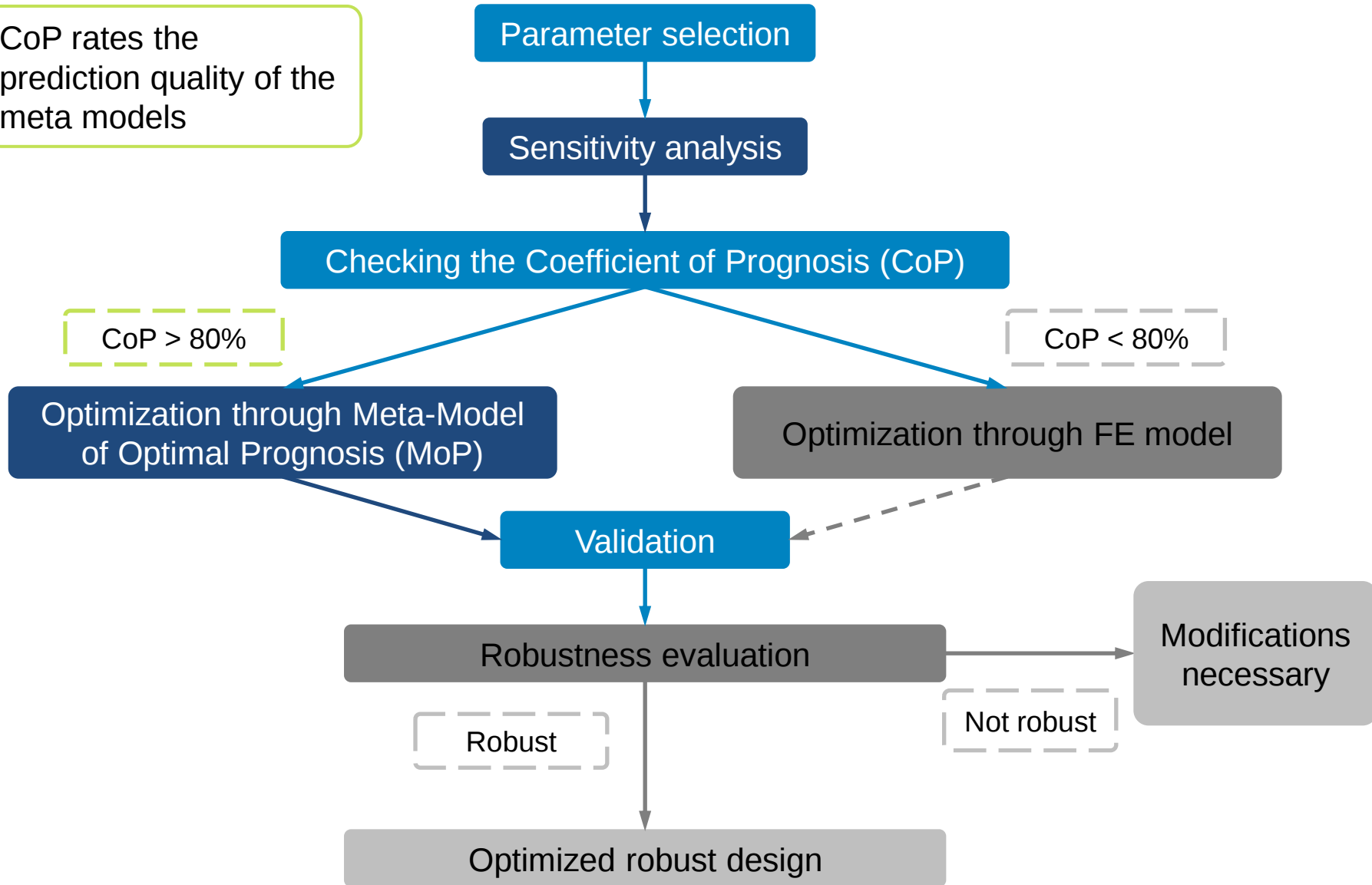
3: Correlation of parameters

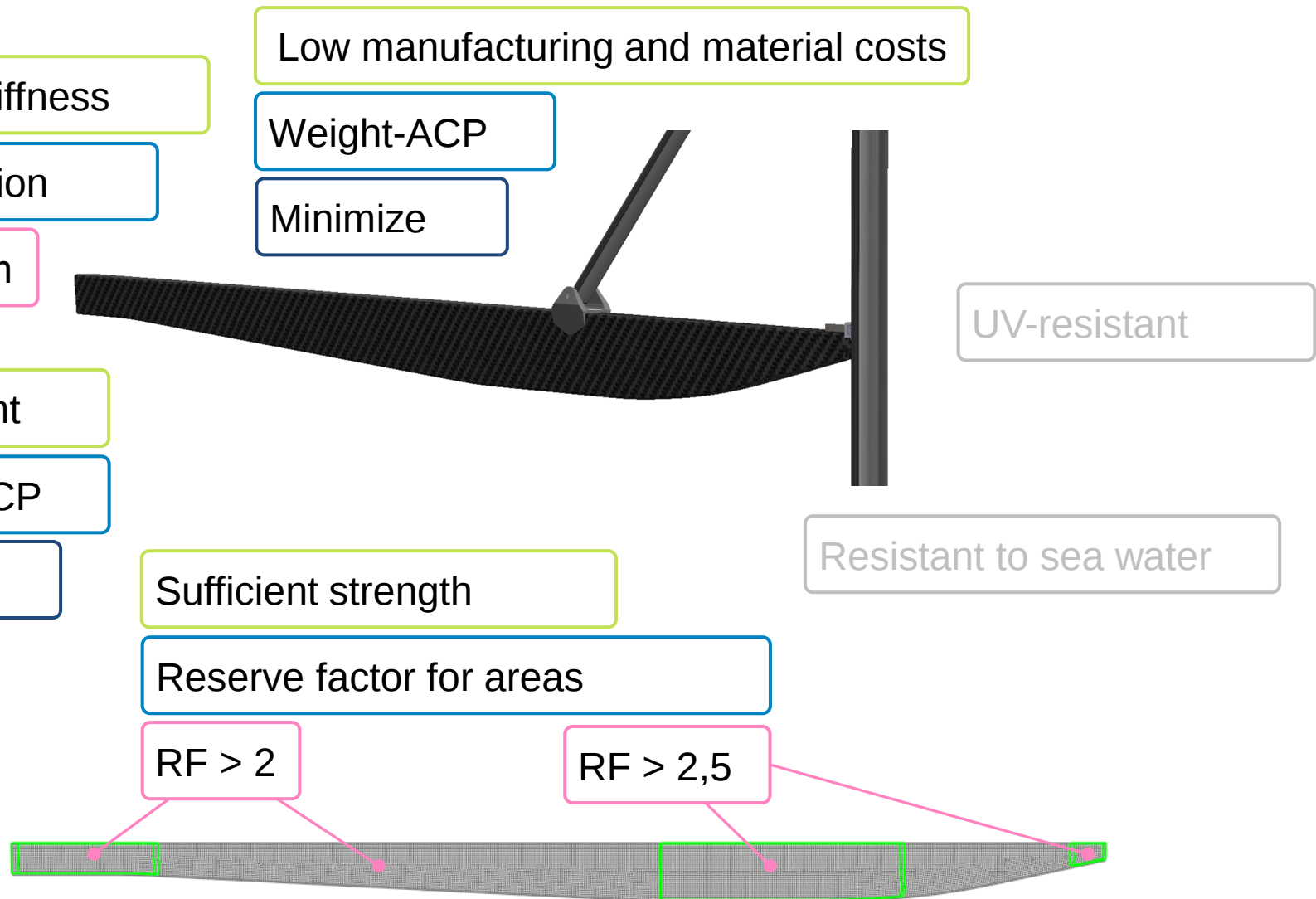


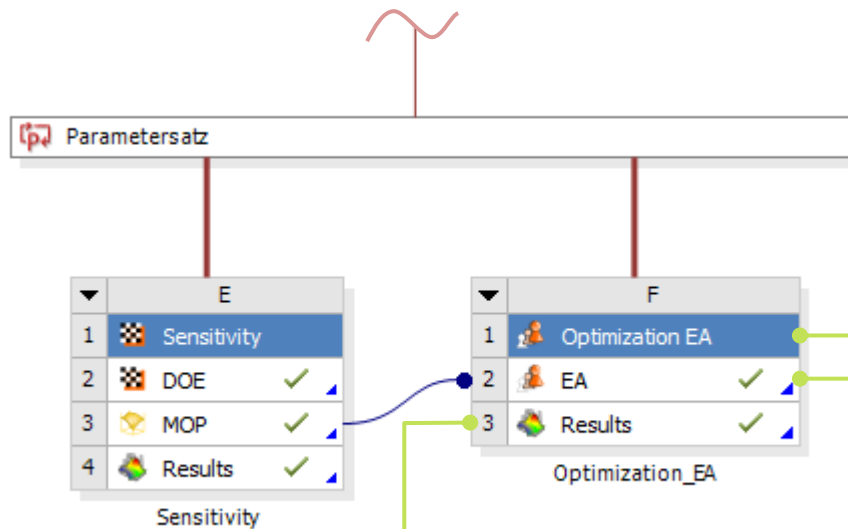
CoP rates the prediction quality of the meta models



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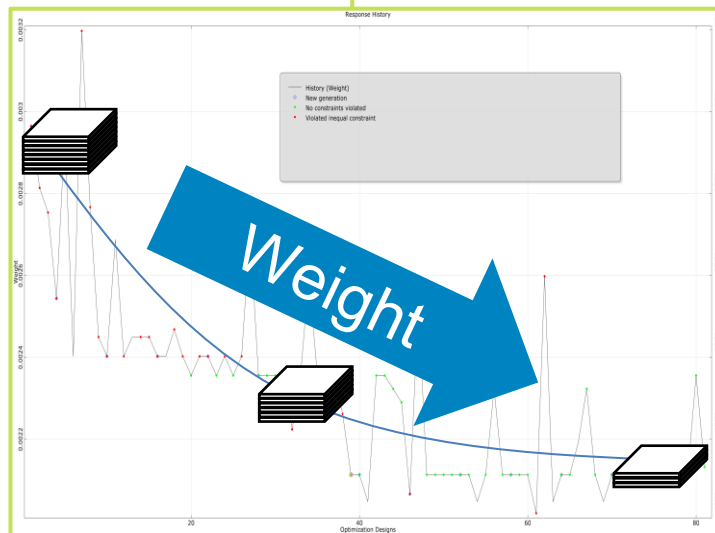


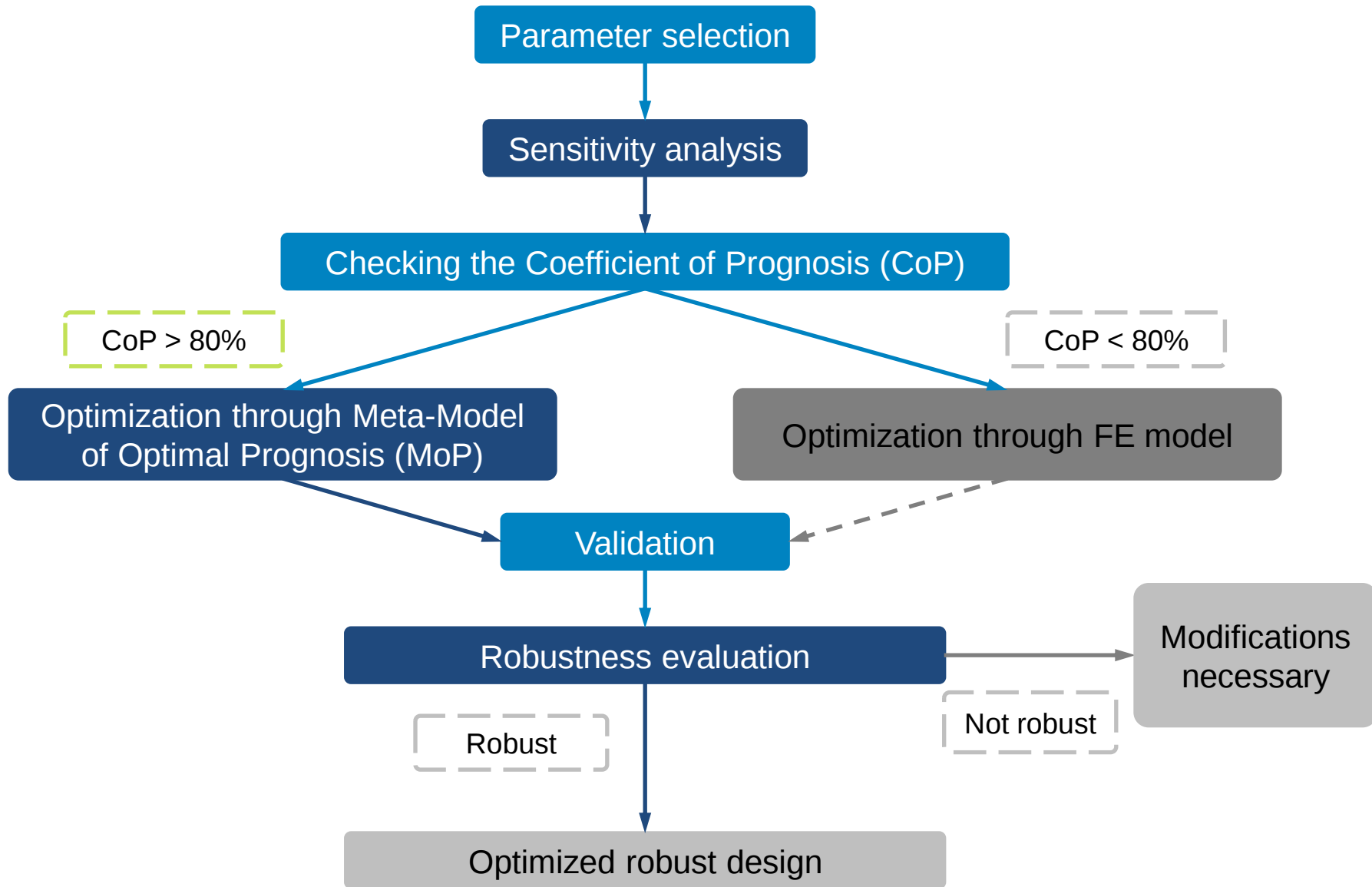


1: Selection of the optimization algorithm

2: Selection of the goals, start design and optimization properties

3: Best design recommendation and validation





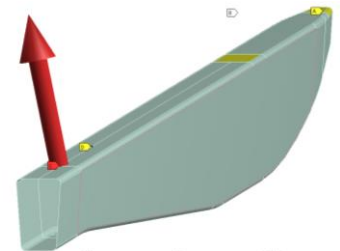
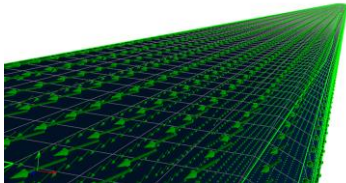
How does the design react to variance?

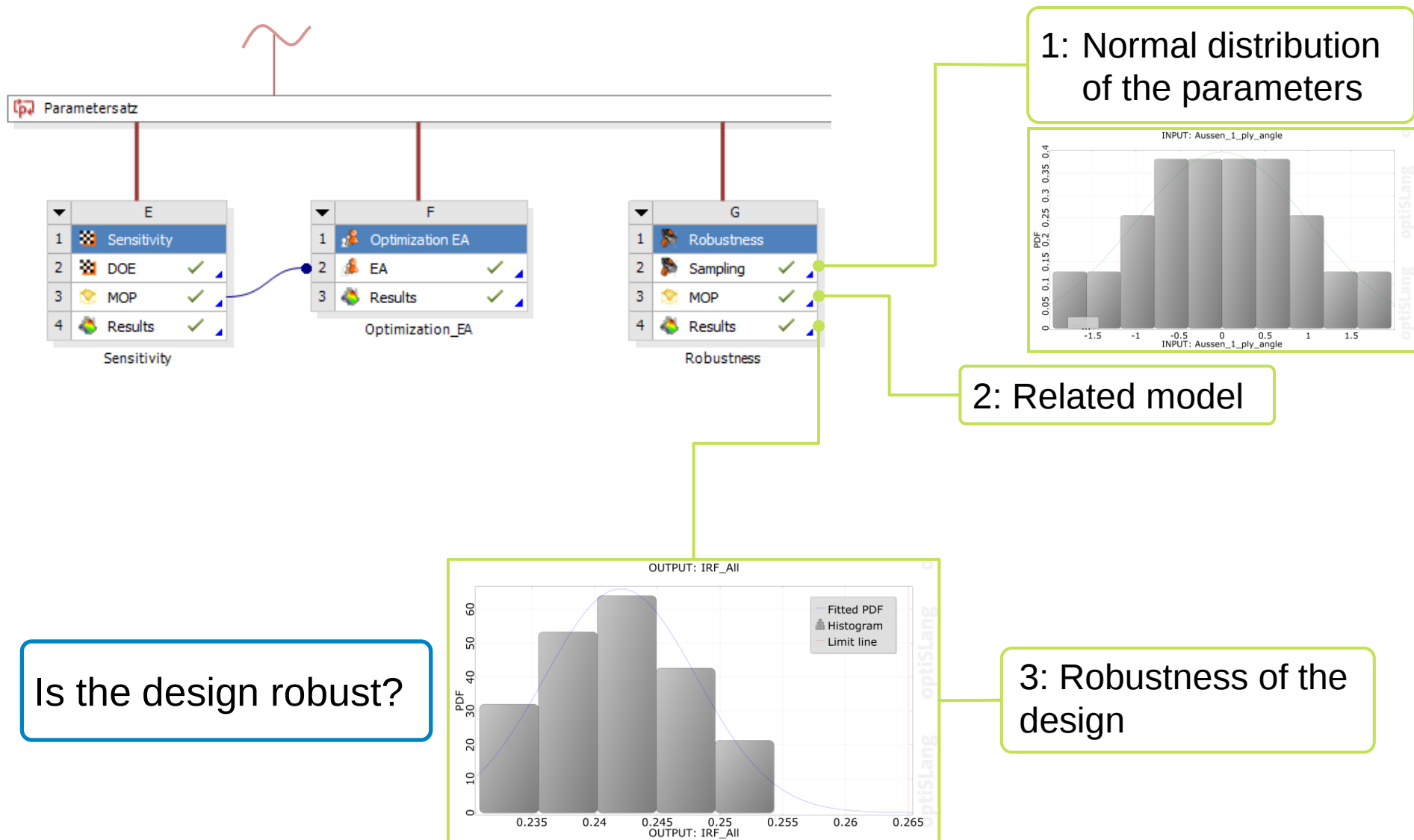
Types of variances

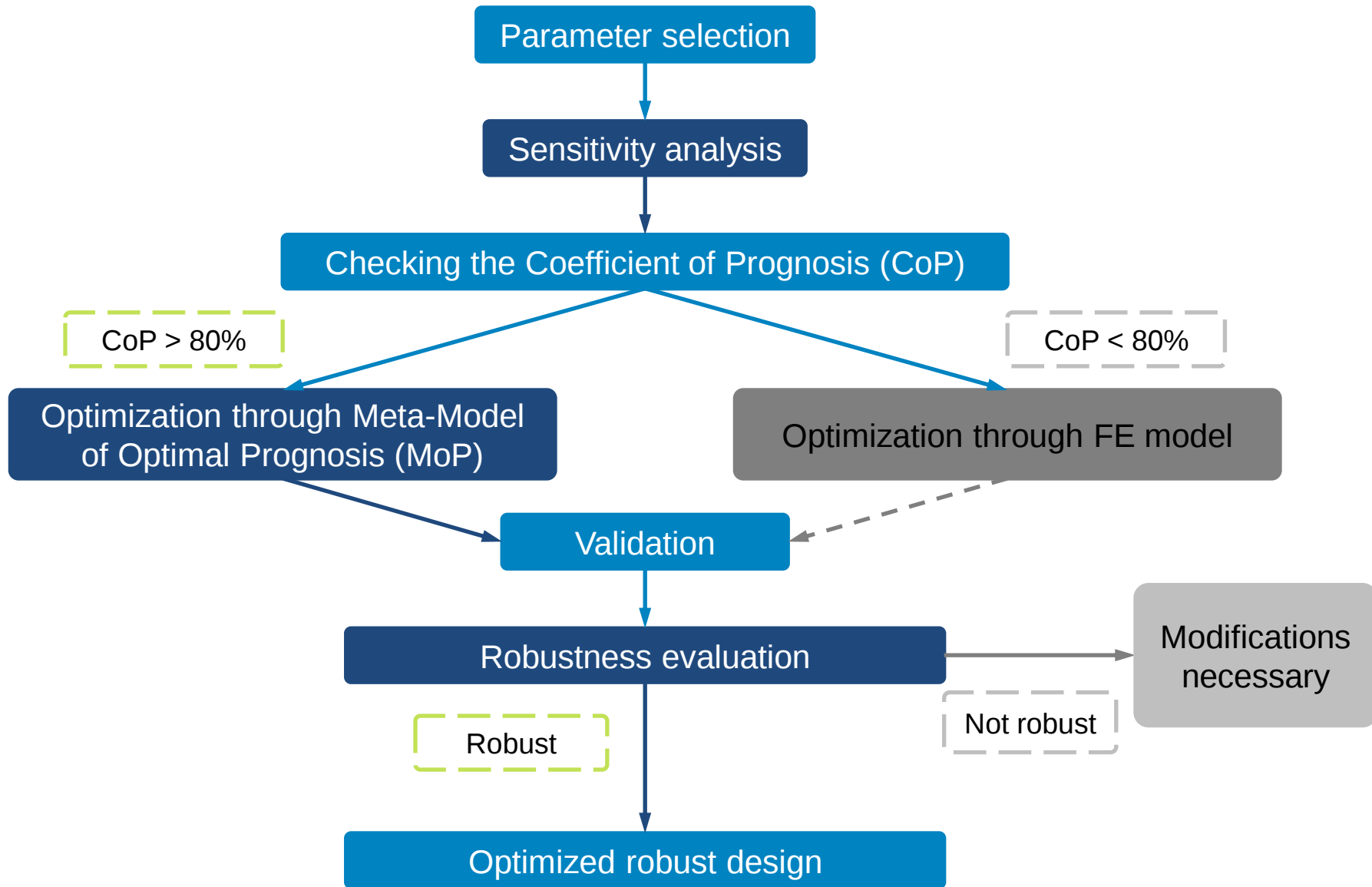
Variance due to
manufacturing

Variance of material
properties

Variance due to the force
direction







ACP Model
01.10.2014 12:13
Deformation - usum
Element-Wise
Unit: mm
Max: 9.9574
Min: 0.017703

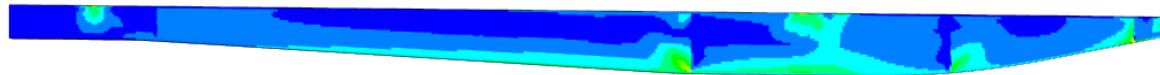
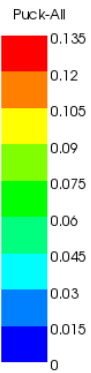
Verformung
ANSYS
R15.0

Verformung



ACP Model
01.10.2014 12:09
Failure - Irf
Element-Wise
Max: 0.24215
Min: 0.00012091

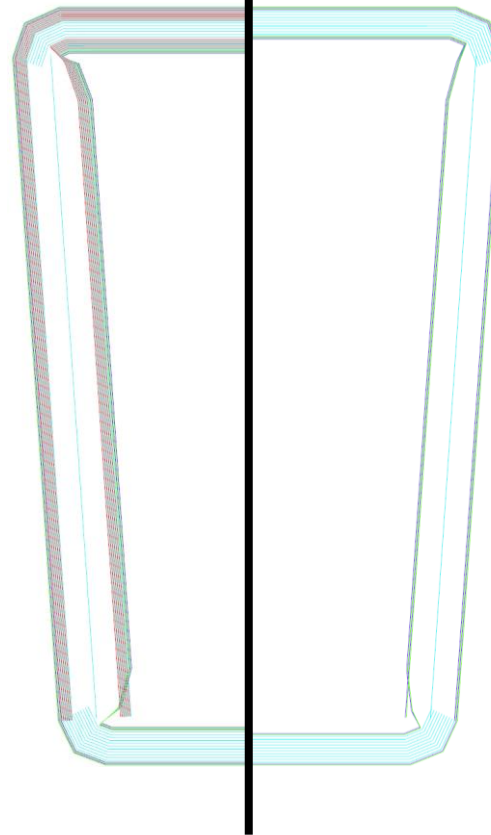
Inverserer Reservefaktor
ANSYS
R15.0



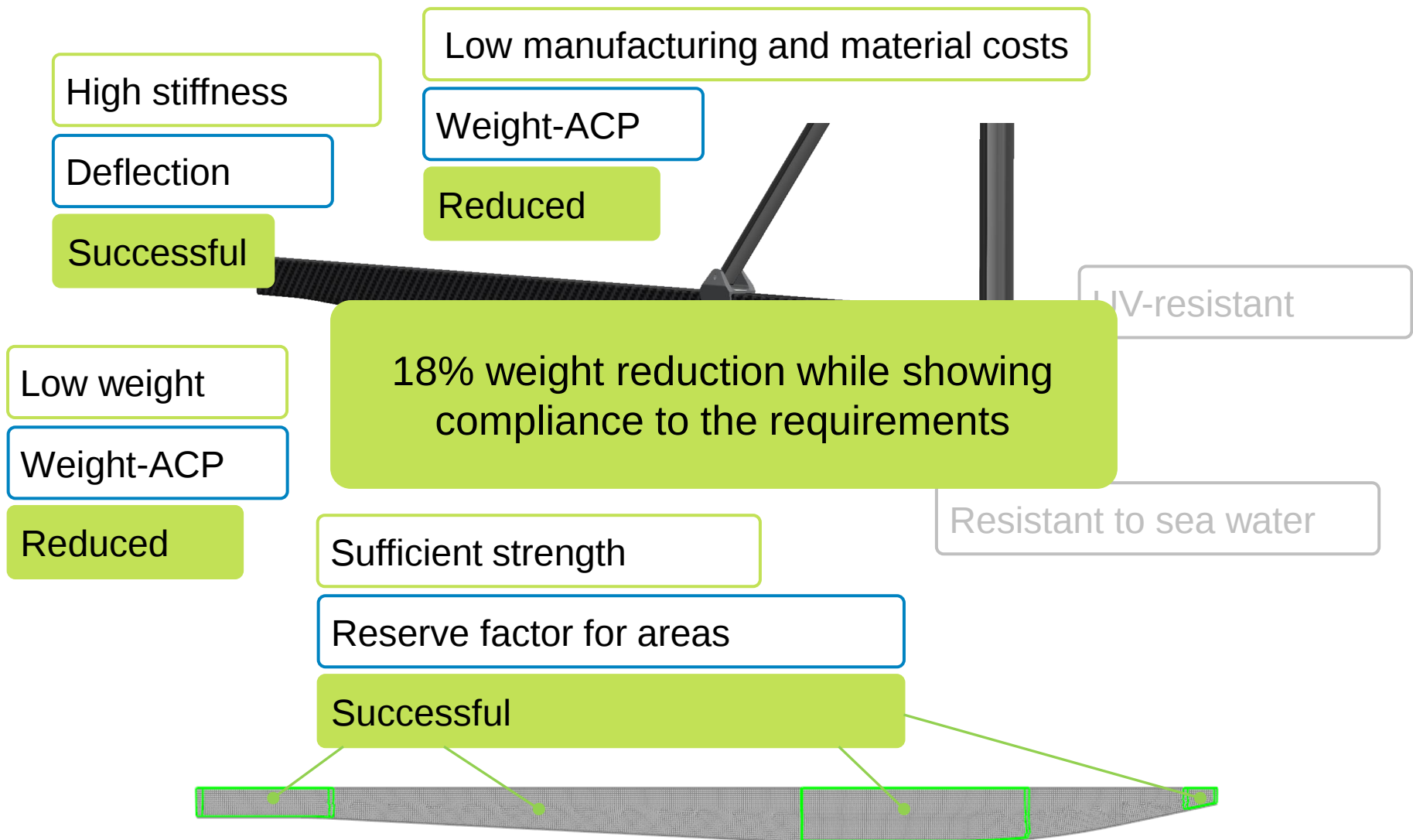
Initial state

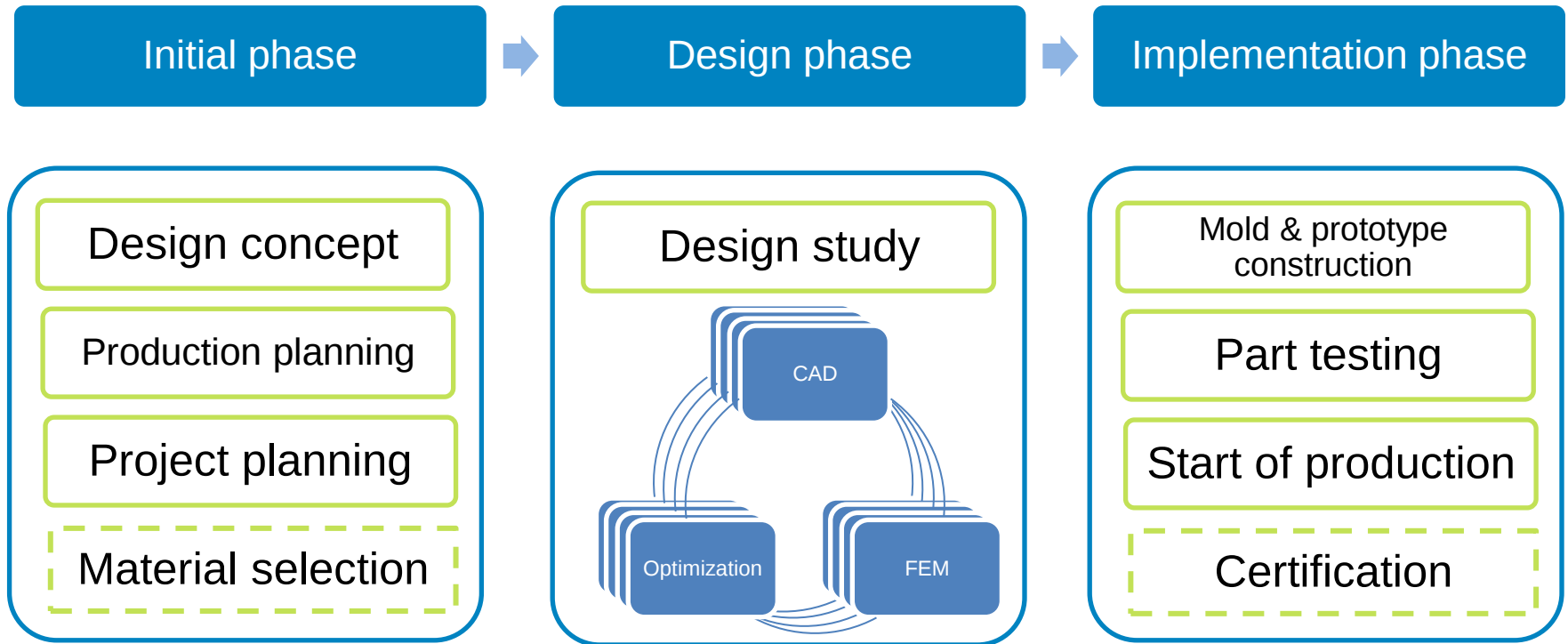


Optimized laminate

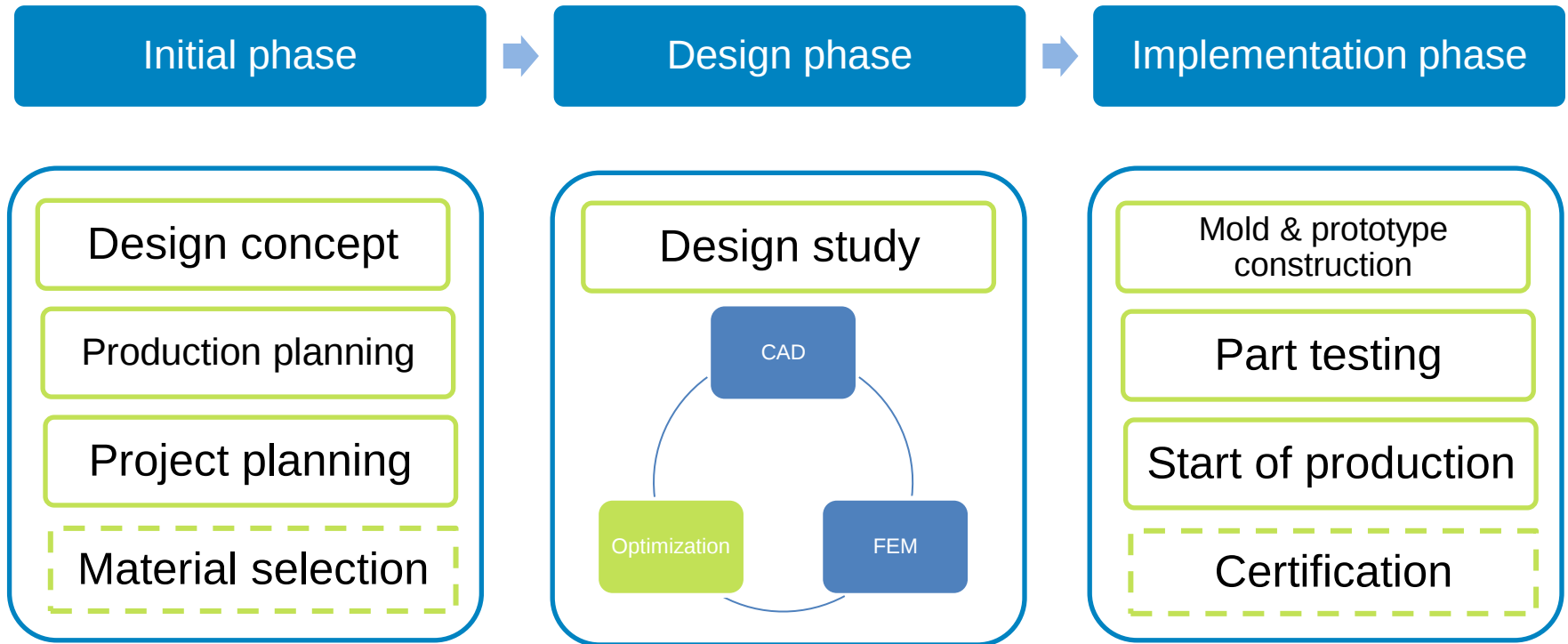


With equal or better mechanical properties





Phases of a composite project



Significant reduction of iteration steps save time and money

Good part quality due to composite know-how and use of optimization tools



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CEO

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