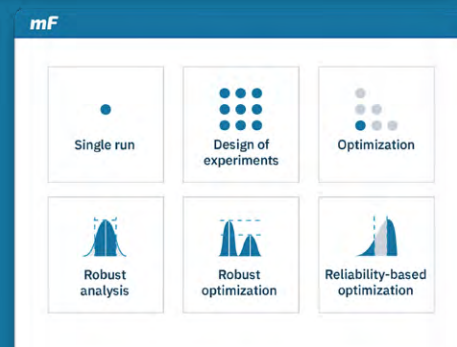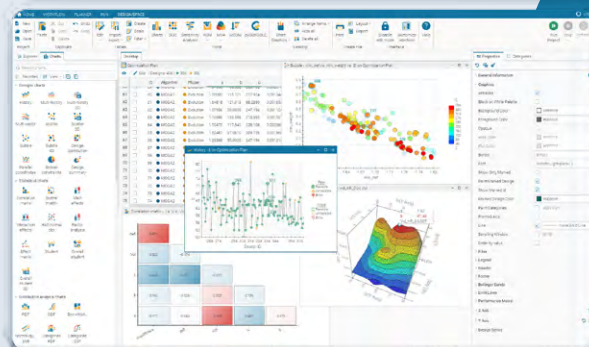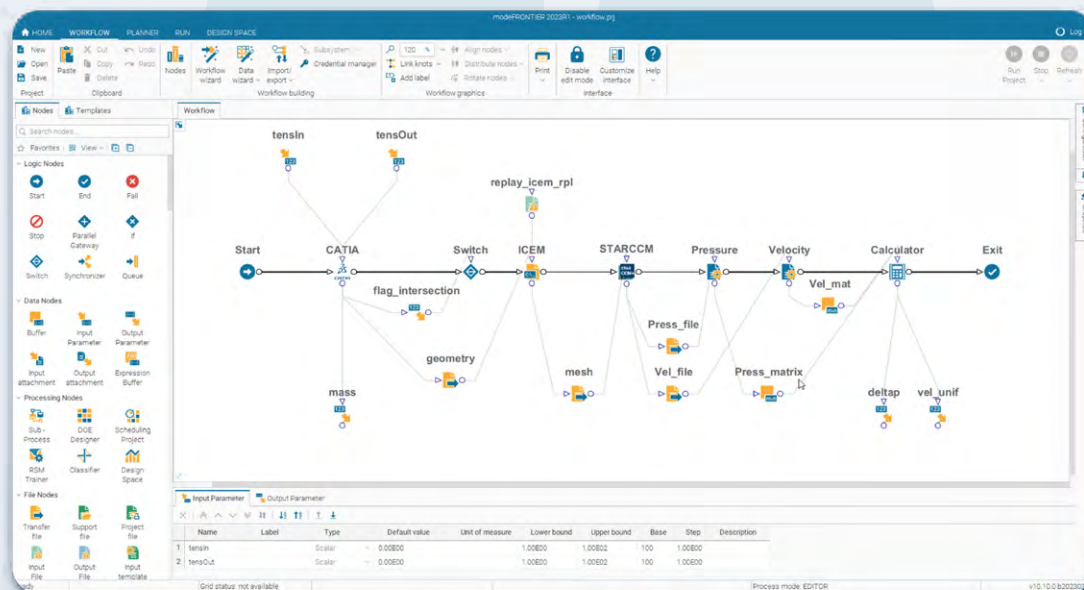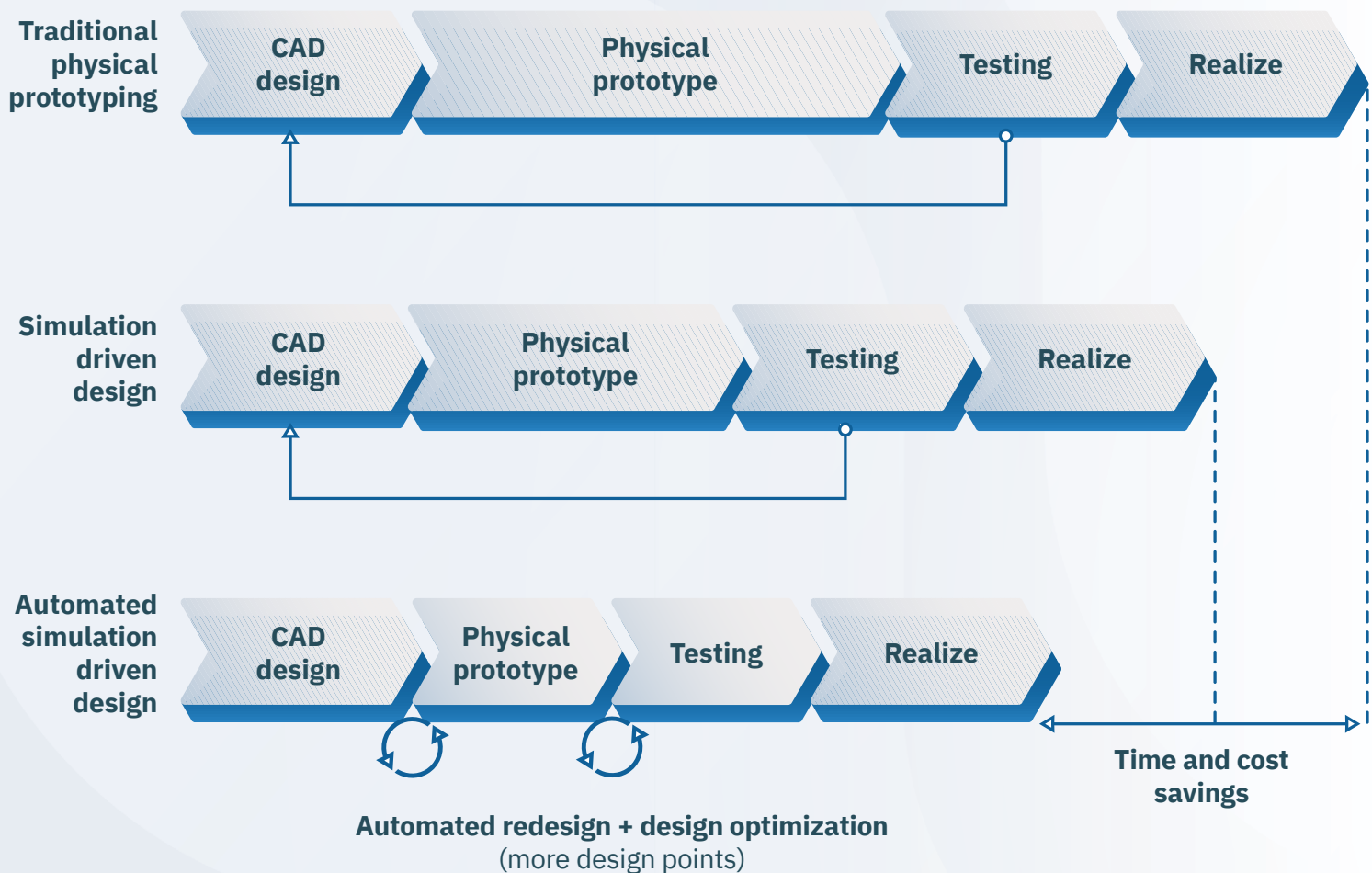# *modeFRONTIER*

Eliminate endless simulation iterations. Unleash innovation to design better products faster

The vendor agnostic software for process automation and design optimization

esteco.com/**modeFRONTIER**

Business challenge: time and cost savings

Traditional physical prototyping

| CAD design | Physical prototype | Testing | Realize |

Simulation driven design

| CAD design | Physical prototype | Testing | Realize |

Automated simulation driven design

| CAD design | Physical prototype | Testing | Realize |

Automated redesign + design optimization
(more design points)

Time and cost savings

Traditional physical prototyping
Physical prototyping is both costly and time-consuming, which makes it inefficient for early design stages where changes occur quickly and frequently. Similarly, it is less ideal for later stages of product development, which involve reviewing and refining the designs of complex structures like vehicles and aircraft.
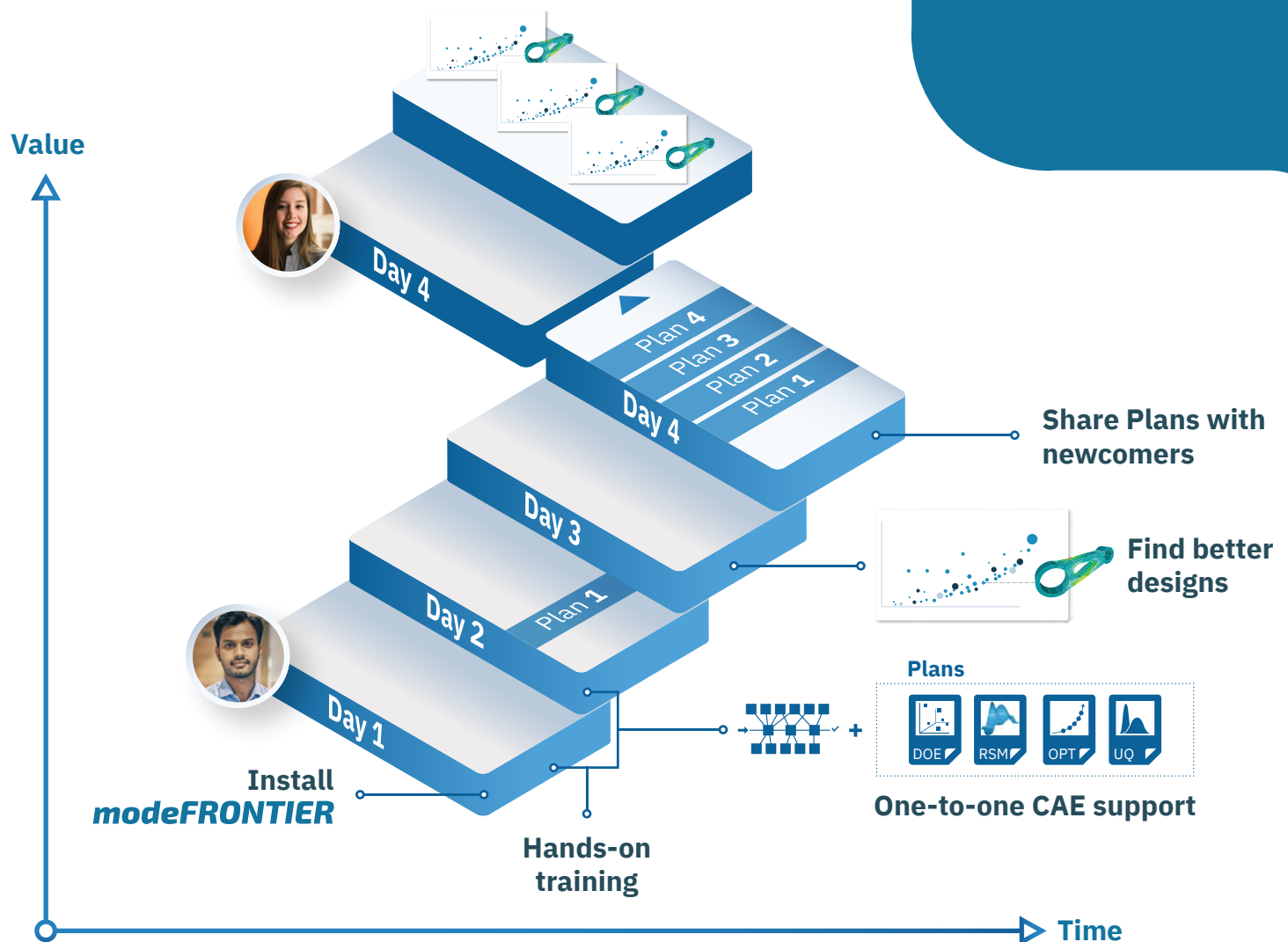
Simulation-driven design
CAE simulations allow to build virtual prototypes but the process remains heavily reliant on trial-and-error. It necessitates manual adjustments to geometry, the creation of new meshes, and repeated simulations until the optimal design is identified. This iterative process demands specific expertise in the field and considerable time investment.

Automated simulation-driven design
This approach enables the automatic evaluation of thousands of designs by integrating CAD/CAE solvers within a single automated workflow enhanced with design exploration or optimization methods. The main challenge lies in lowering the barriers to parametric design optimization adoption, which can lead to substantial savings in both time and cost during product development.

The ideal scenario for effective design optimization

Value

Day 4

Plan **4**
Plan **3**
Plan **2**
Plan **1**

Day 4

Share Plans with newcomers

Day 3

Day 2

Plan **1**

Find better designs

Day 1

Plans

DOE   RSM   OPT   UQ

Install modeFRONTIER

One-to-one CAE support

Hands-on training

Time

Day 1

Install modeFRONTIER
Gain proficiency to set up simulation workflows with hands-on training.

Day 2

One-to-one CAE support
Apply the most appropriate strategy for your design challenge.

Day 3

Find better designs
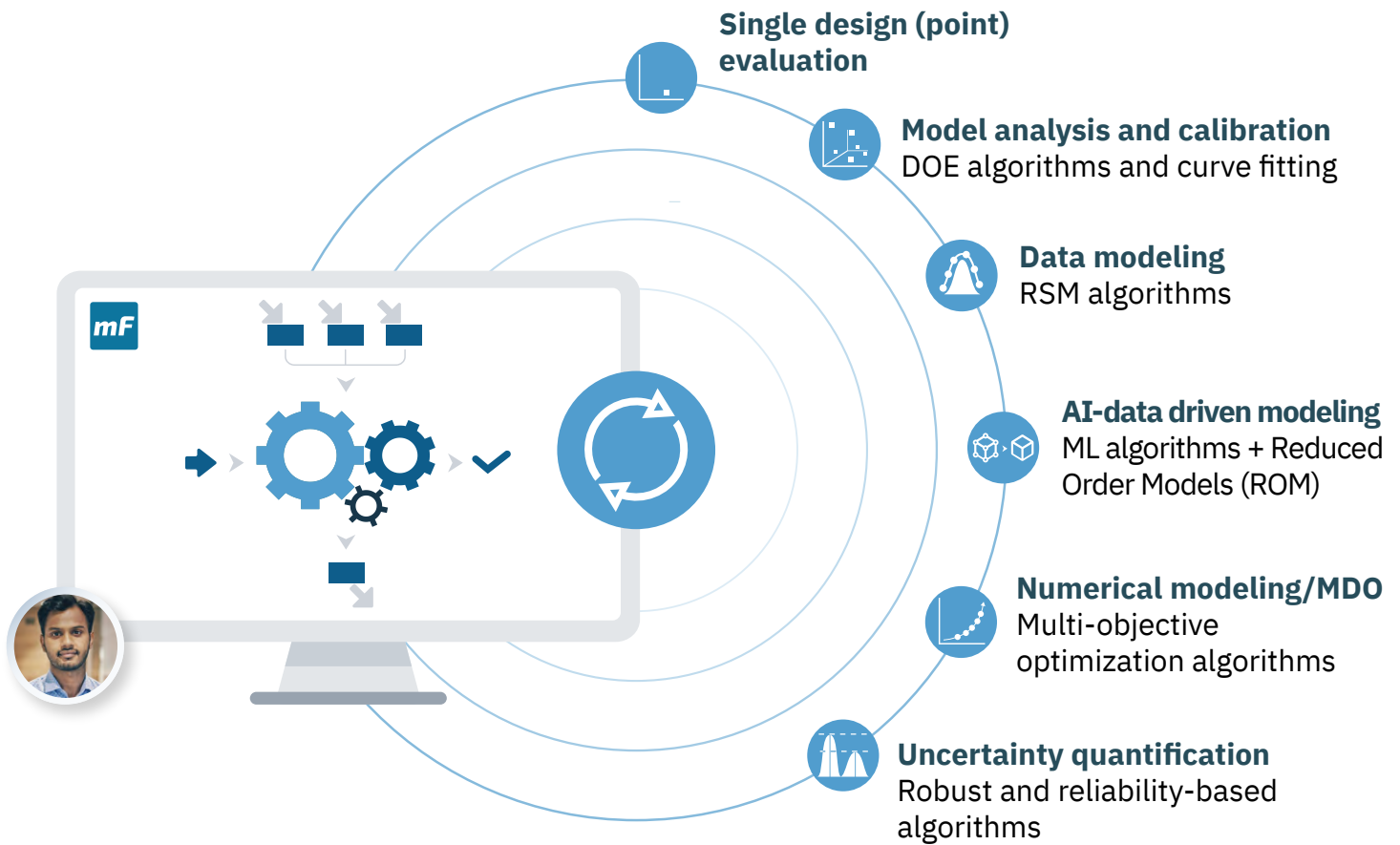Evaluate thousand of designs by applying various run configurations (Plans) to the same simulation workflow.

Day 4

Share Plans with newcomers
Re-use design exploration and optimization strategies to conduct further analysis.

The modeFRONTIER incremental optimization-driven design approach

Single design (point) evaluation

Model analysis and calibration
DOE algorithms and curve fitting

Data modeling
RSM algorithms

AI-data driven modeling
ML algorithms + Reduced Order Models (ROM)

Numerical modeling/MDO
Multi-objective optimization algorithms

Uncertainty quantification
Robust and reliability-based algorithms

Why modeFRONTIER?

High-quality code base and continuous development

The most versatile application of optimization

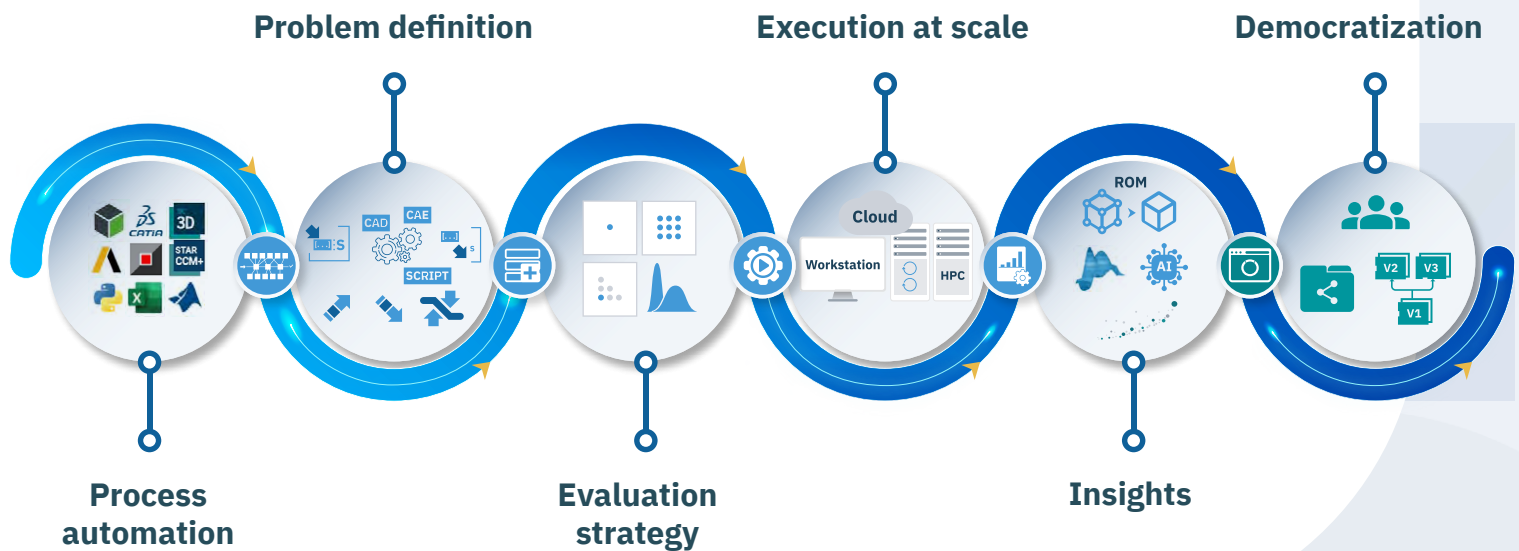**Simplified optimization experience**

25+ years experience in numerical methods
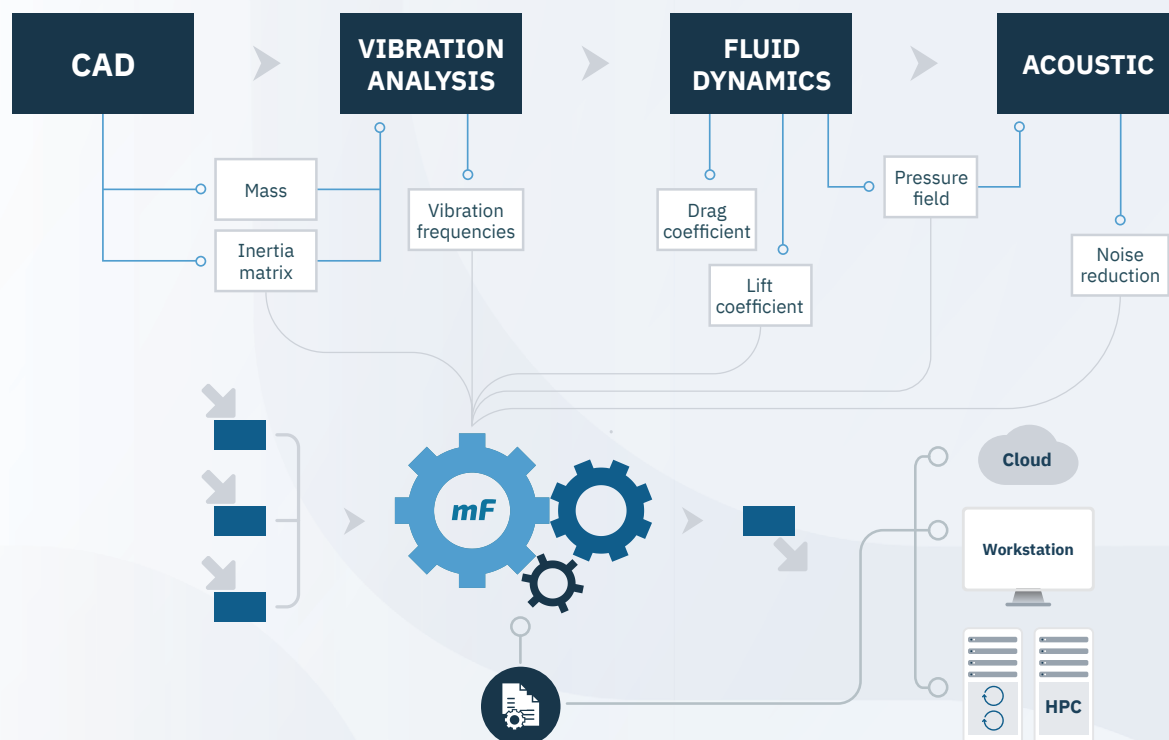
Python ecosystem

One-to-one CAE engineering support

Core capabilities
The modeFRONTIER process flow

Problem definition

Execution at scale

Democratization

Process automation
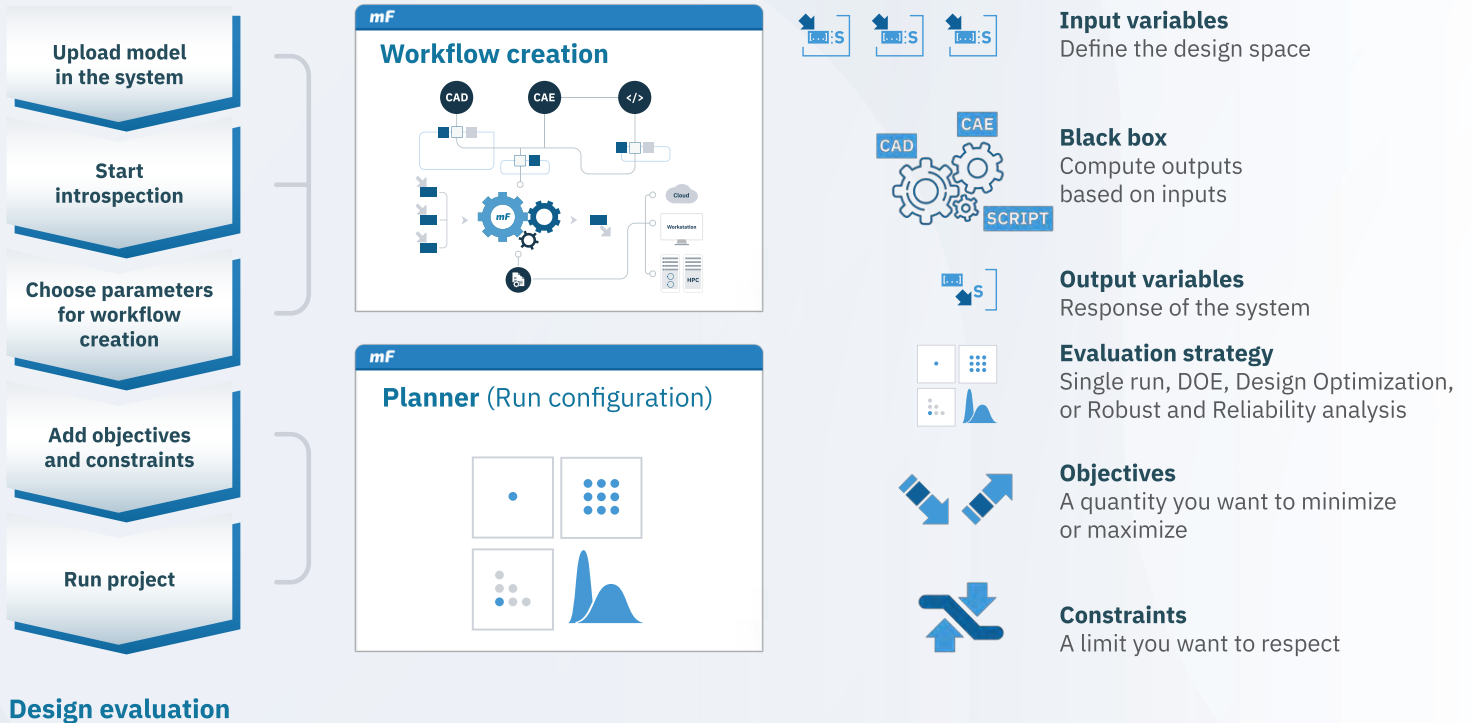
Evaluation strategy

Insights

Simulation workflow automation and integration

modeFRONTIER's vendor neutral simulation workflow allows you to automate any CAD/CAE and in-house solvers with no coding, and drive simulation chains by interacting with your Python API. Then, you can actionate any simulation/experimental model, and exploit the interaction between the disciplines and determine the global optimum design. modeFRONTIER job scheduling technology lets you balance the computational load by concurrently executing design evaluations and distributing solver runs on dedicated HPC and cloud environments.

CAD > **VIBRATION ANALYSIS** > **FLUID DYNAMICS** > **ACOUSTIC**

Mass

Inertia matrix

Vibration frequencies

Drag coefficient

Lift coefficient

Pressure field

Noise reduction

mF

Cloud

Workstation

HPC

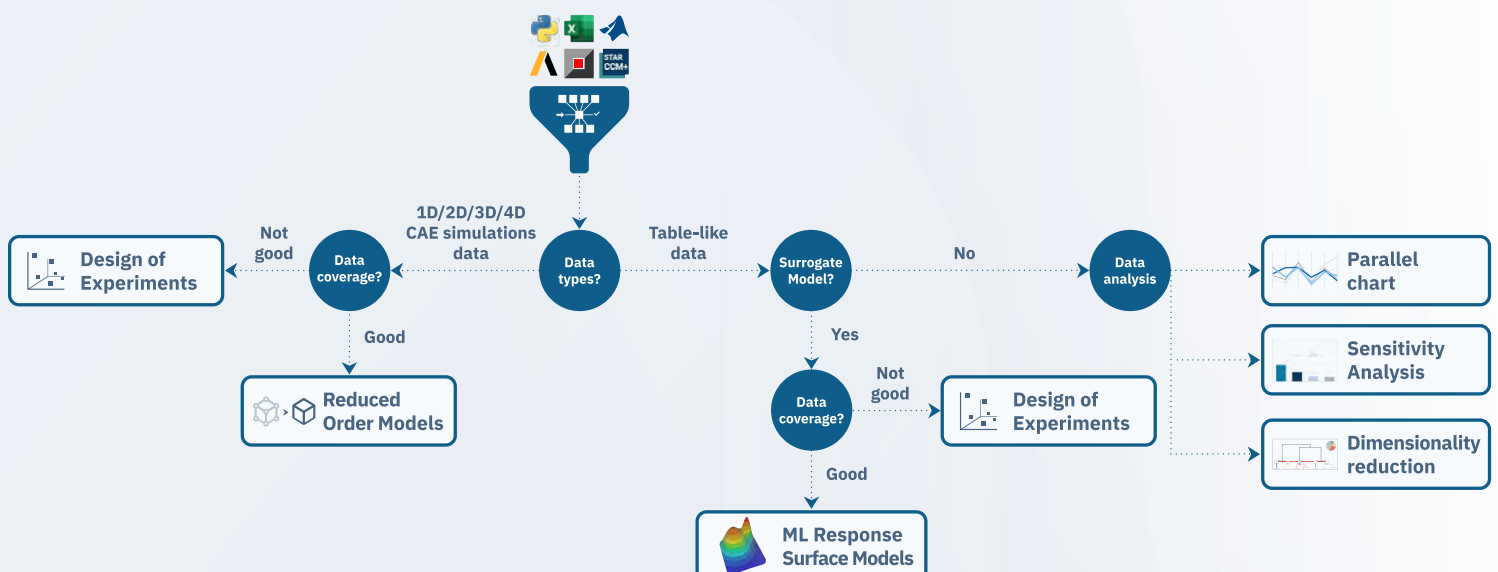# Problem definition and evaluation strategy set-up

Focus on the logic of your engineering process during the workflow construction phase. Multiple design exploration and optimization strategies can be practically defined in the separated modeFRONTIER Planner environment. With this approach, you are able to explore various parameters, constraints, and goal configurations for the same engineering process and compare the design solutions in a single place.

Upload model in the system

Start introspection

Choose parameters for workflow creation

Add objectives and constraints

Run project

Design evaluation

mF
Workflow creation

CAD   CAE   </>

mF

Cloud
Workstation
HPC

mF
Planner (Run configuration)

Input variables
Define the design space

Black box
Compute outputs based on inputs

Output variables
Response of the system

Evaluation strategy
Single run, DOE, Design Optimization, or Robust and Reliability analysis

Objectives
A quantity you want to minimize or maximize

Constraints
A limit you want to respect

AI/ML process data flow

Develop computationally efficient surrogate models that expedite the exploration of complex design spaces:

- Leverage Response Surface Models (RSM) and machine learning (ML) algorithms (including Python-based ML libraries) for RSM training.
- Apply Explainable AI technology through Reduced Order Models (ROM) to obtain a surrogate of the whole 3D CAE solution, while significantly reducing computational costs.

Design of Experiments

Not good

Data coverage?

Good

Reduced Order Models

1D/2D/3D/4D CAE simulations data

Data types?

Table-like data

Surrogate Model?

Yes

Data coverage?

Not good

Design of Experiments

Good

ML Response Surface Models

No

Data analysis

Parallel chart

Sensitivity Analysis

Dimensionality reduction

Configure optimization algorithms in one click

By defining just one parameter or none at all for the autonomous approach, modeFRONTIER opens its door to non-expert users or those experts who just want to effectively investigate the design space while minimizing the amount of iterations required.


Insights

With multi-dimensional design charts, you can interpret data in a meaningful way, visualize optimization trends and distributions to identify best design candidates. modeFRONTIER is also empowered with advanced post-processing tools such as sensitivity analysis, clustering, Self Organizing Maps (SOM), Principal Component Analysis (PCA) and Multi-Criteria Decision Making (MCDM).
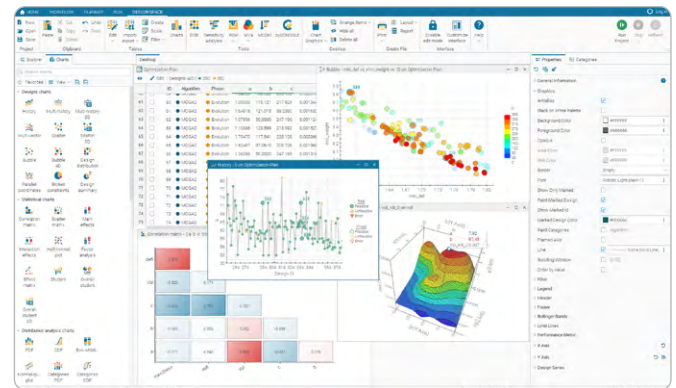
Democratization

Connect to ESTECO VOLTA digital engineering platform. It allows you to scale modeFRONTIER usage across teams for collaborative MDO.

VOLTA provides modeFRONTIER users with features related to collaboration, distributed execution of designs, and traceability of optimization results.
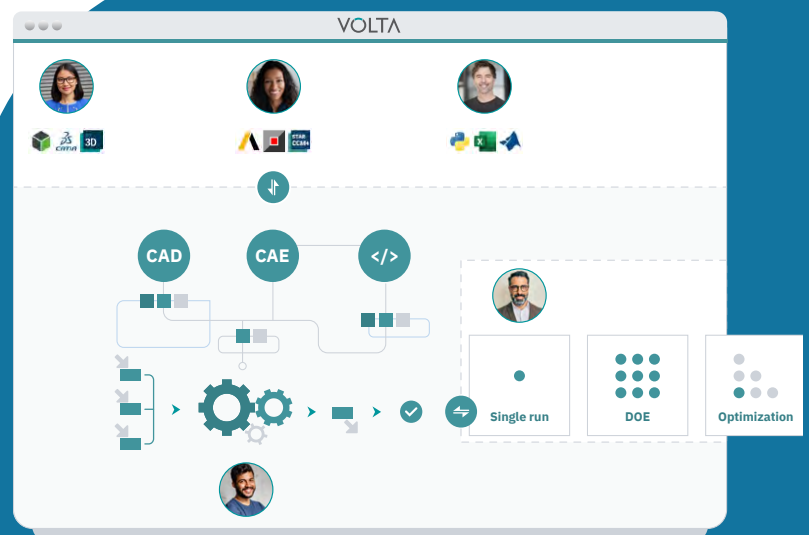
Value-driven partnership with our customers

FORD MOTOR COMPANY

"Vehicle architecture brings together many competing attributes like appearance, performance, range and vehicle dynamics. modeFRONTIER enables us to take the tools from the experts in vehicle dynamics, range or performance, and integrate them into the simulation workflow."

HONDA

"modeFRONTIER helped achieve five-star Euro NCAP for head protection. The overall optimization process allowed us to reduce 6% of the crash deformation compared to the conventional aluminum hood and satisfy Head Injury Criterion target values."
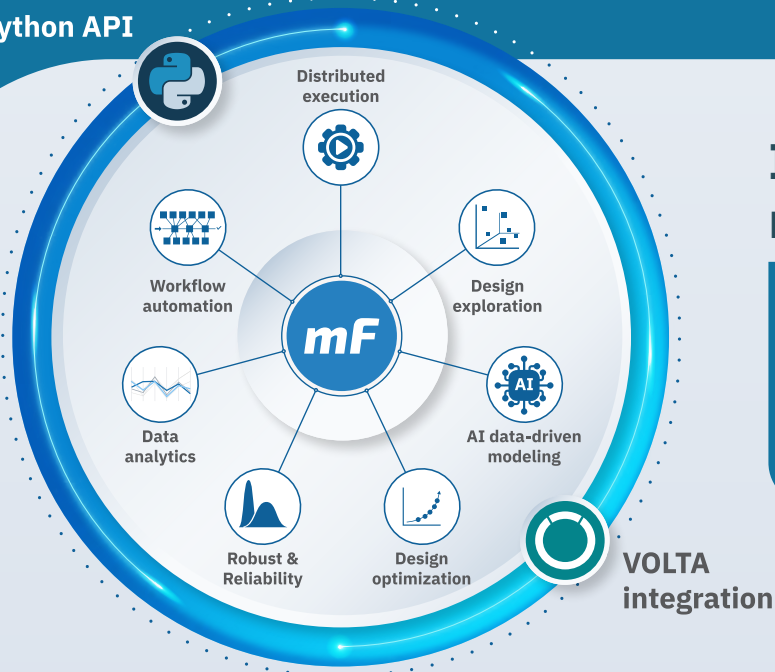
LEONARDO

"modeFRONTIER has proven to be an effective tool for the design team, identifying feasible solutions and achieving a 2.5% enhancement of aerodynamic performance and a 4% wing weight reduction."

LUNA ROSSA PRADA PIRELLI

"modeFRONTIER ticks all of the boxes: a flexible optimization tool that provides us with a wide range of state-of-the-art optimization algorithms, easy-to-use, allowing our engineers to be productive almost immediately. And, it's a proven software product with a long record of successful usage."

Python API

- Distributed execution
- Design exploration
- AI data-driven modeling
- Design optimization
- Robust & Reliability
- Data analytics
- Workflow automation
- **VOLTA integration**

Interested in trying modeFRONTIER hands-on?

Schedule a live demo tailored to your needs.

sales@esteco.com