



EXPLORE DESIGN PERFECTION



Web-based Collaboration for Optimization Driven Design

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VOLTA Product Manager

NAFEMS SDMWG monthly meeting
May 2108

esteco.com





We help companies design the products of the future, TODAY.



What if ..

- experts could focus no more added value engineering?
- more engineers are enabled to perform the routine analysis tasks?
- corporate knowledge is captured and re-used?
- simulation is automated?
- IT managers can reduce time and costs of software deployments?



User
Experience


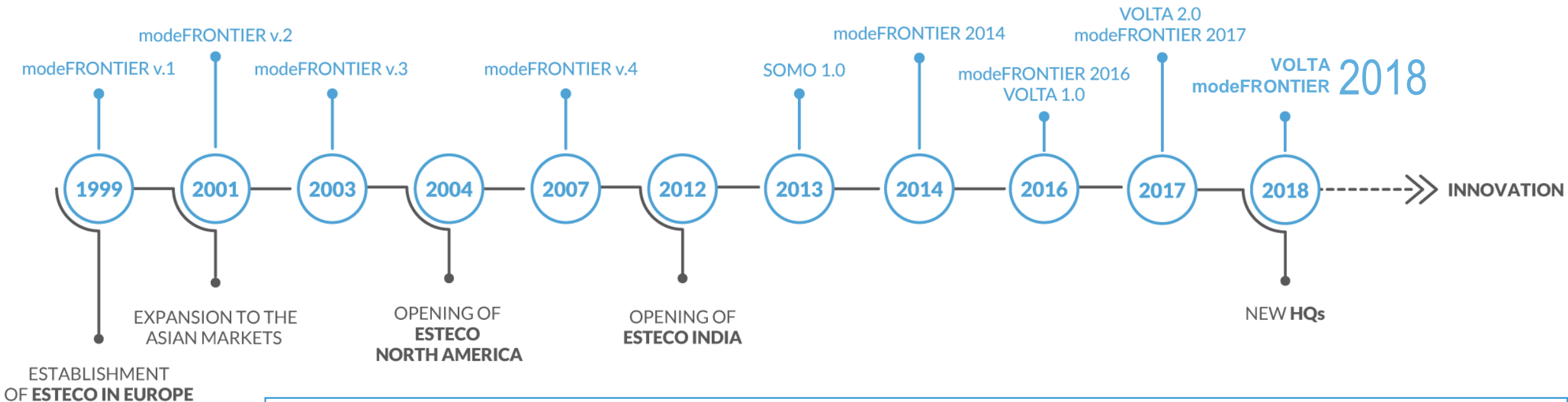
Democratization

Standardization and Interoperability





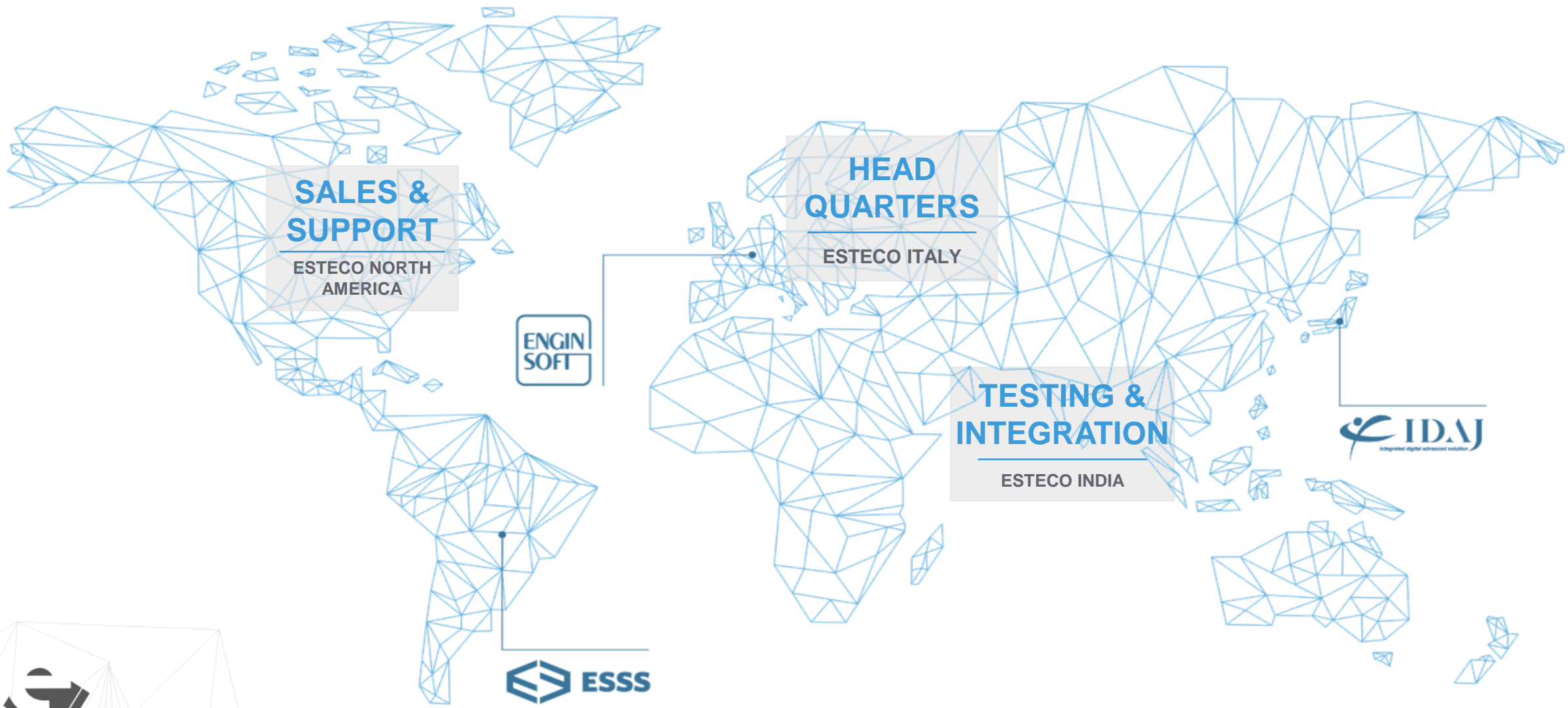
A journey started some years ago



ESTECO is an independent software provider, highly specialized in numerical optimization and simulation data management with a sound scientific foundation and a flexible approach to customer needs.



>> Global presence





ESTECO Values

INNOVATIVE

RELIABLE

INDIPENDENT

FLEXIBLE

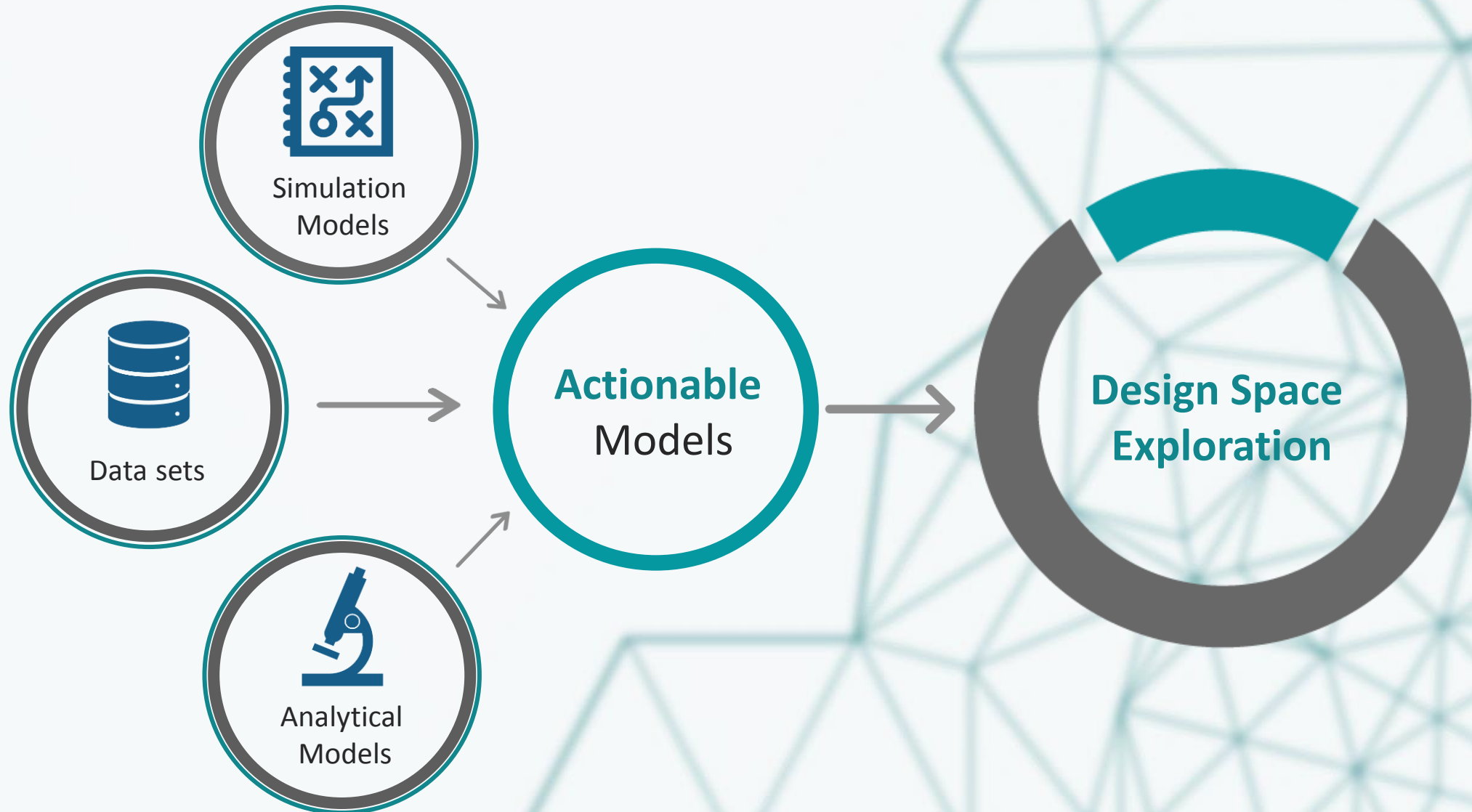
Simplify engineers work, by automating repetitive tasks:

» DESIGN BETTER PRODUCTS, FASTER!

The way products are designed and engineered is changed in the last 20 years. ESTECO continuously research and develop innovative technologies to improve products design process.

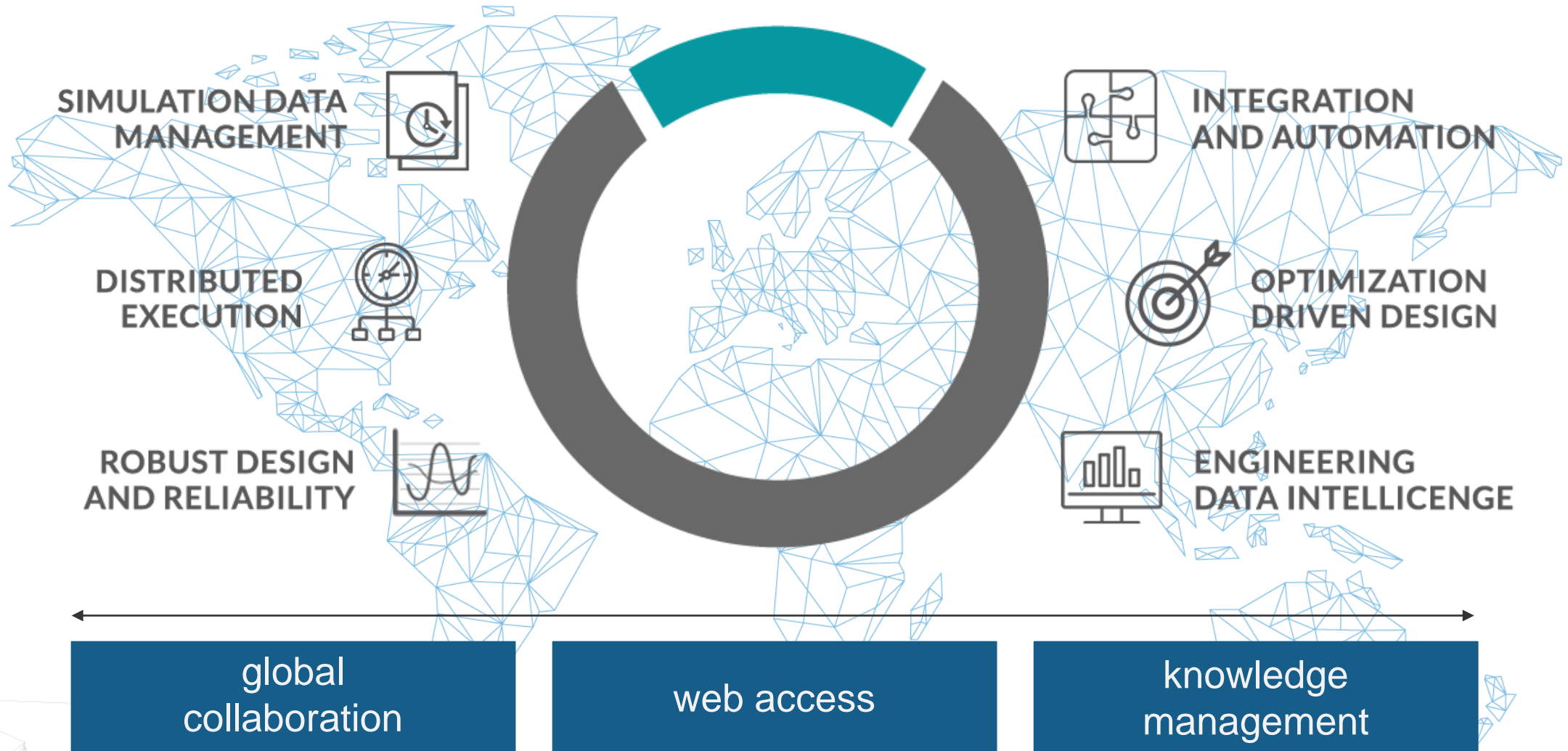


Design Space Exploration with ESTECO Technologies





VOLTA





modeFRONTIER



Desktop Client GUI:

- Workflow Authoring
- Optimization and Robust Design
- Advanced Data Analytics
- Response Surfaces Modeling

VOLTA



Web GUI:

- Collaboration
- Simulation Data Management
- Analysis Execution
- Data Intelligence

VOLTA
Distributed Execution

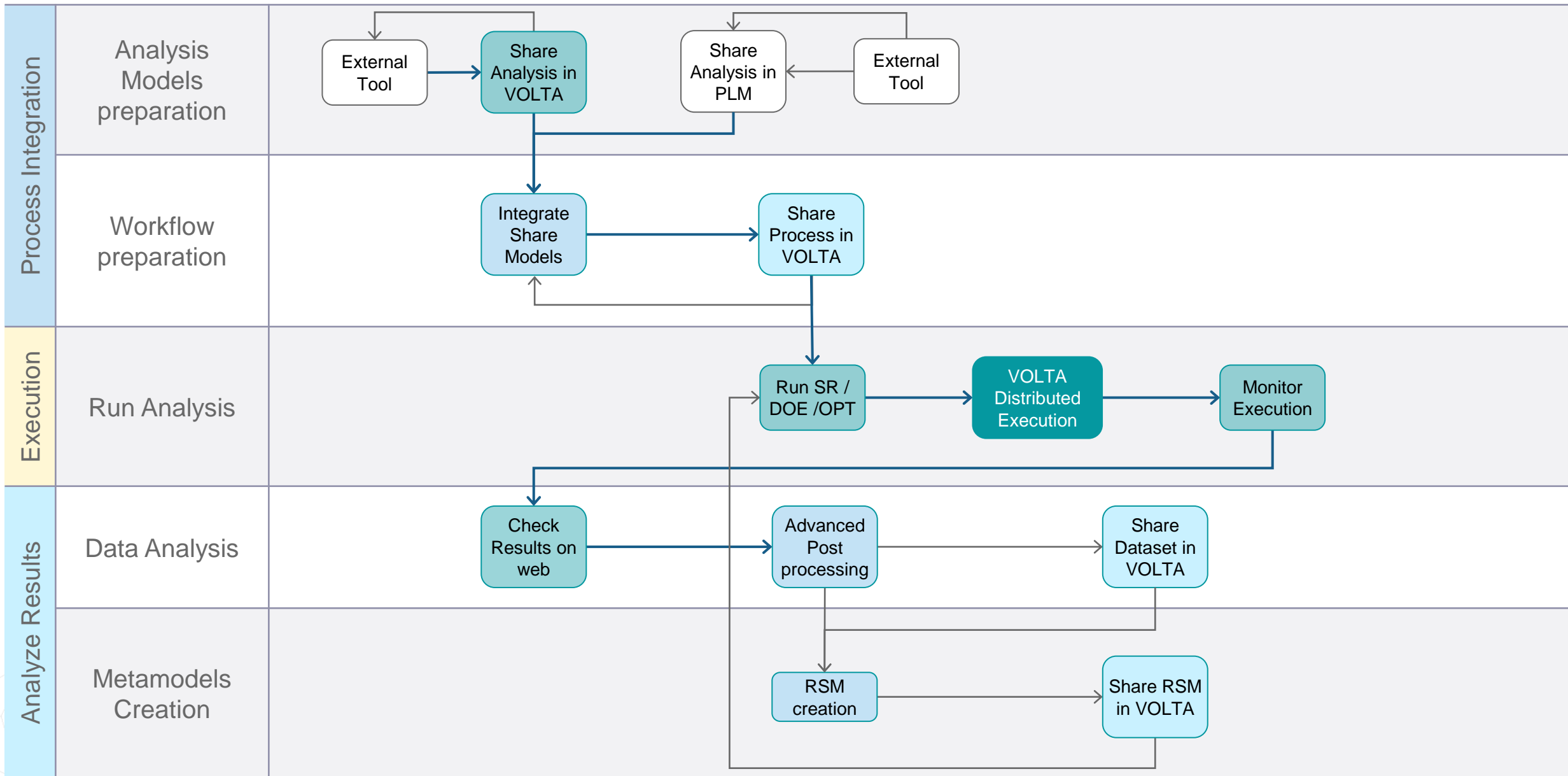


Evaluators + mF Engines:

- Concurrent Execution
- Remote Jobs Management
- Batch Engines Balance



>> VOLTA Scenario



Scenario

Analysis Domain Expert

Analysis Model
Preparation

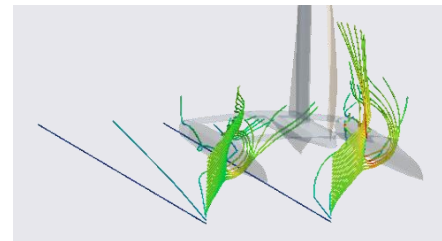
Workflow Preparation

Run Analysis

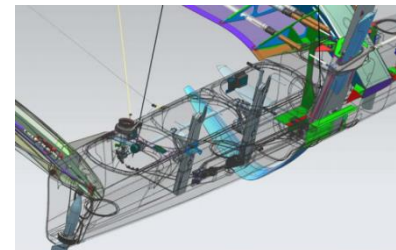
Analyze Data

Metamodel Creation

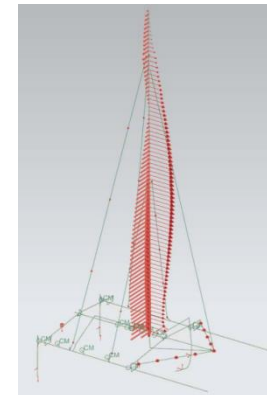
Same product:
Hundreds of tools



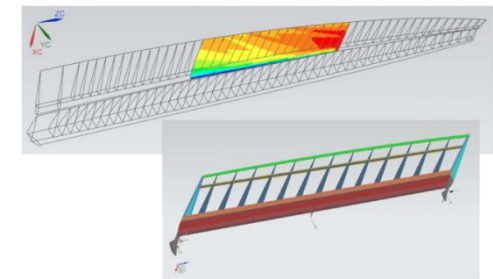
Hydrofoil Systems



System & Control



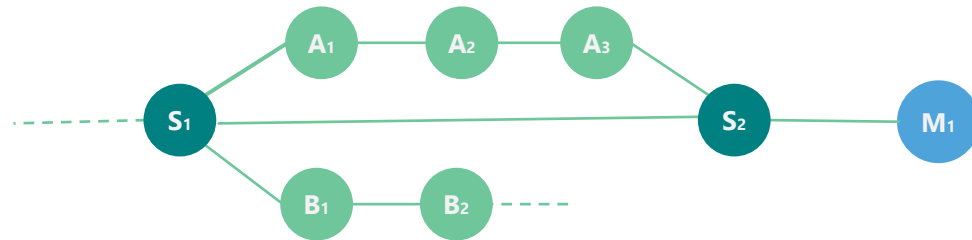
Structural
Response



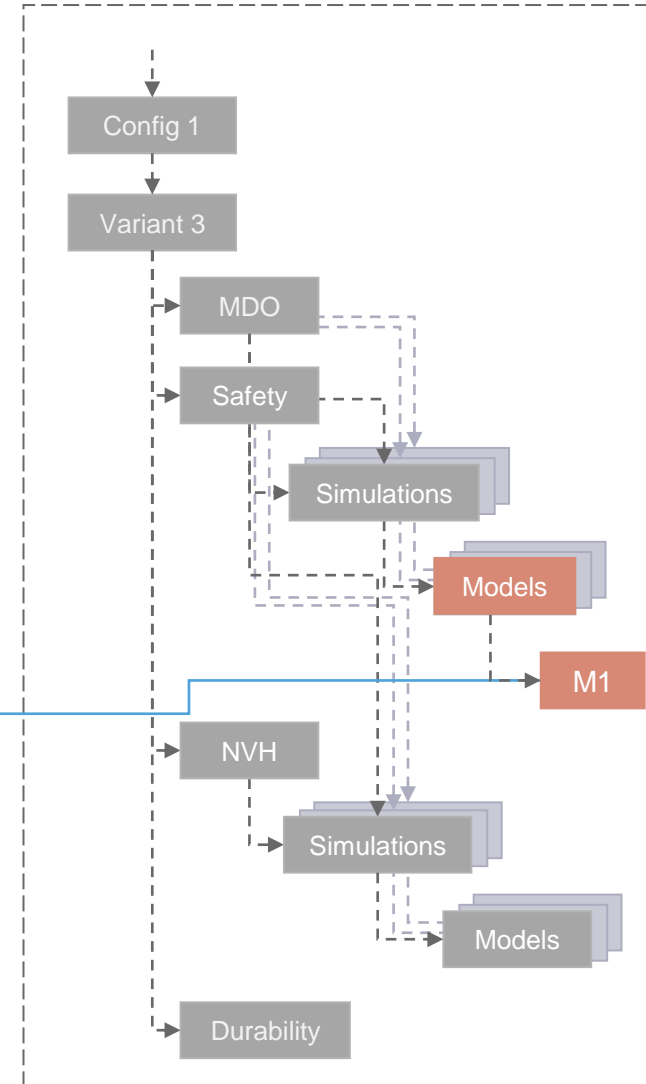
Wing Flap



- Users work in Team Data Manager (TDM): Local Storages, SVN/GIT versioning system for WIP models
- Generates versions (S), revisions (A), milestones (M)



- Publish reviewed milestones to PDM/PLM and VOLTA repository



SIMULATION DATA MANAGEMENT

Build Knowledge

capture, version and share interdisciplinary engineering knowledge across the enterprise.

Track Changes

access and share the latest, most up-to-date information anytime and from any location.

Control User Access

profile-based access and item level permissions.

The screenshot displays the VOLTA TEAM web interface. The top navigation bar includes a search bar and buttons for 'Rename team' and 'Edit members'. The main content area shows a file tree on the left and a list of files in the center. The selected file, 'BinKorn_function', has its details shown on the right.

ESTECO Global

FILES TRASH

ESTECO Global / Special Projects / Mathematical Benchmarks

Tree Details

NAME	CREATED	CREATOR	SIZE
Ackley_function	Apr 11, 2018	mnicolich	-
BinKorn_function	Apr 11, 2018	mnicolich	-
Constr_Ex_funct...	Apr 11, 2018	mnicolich	-
Eggholder_funct...	Apr 11, 2018	mnicolich	-
Kursave_funct...	Apr 11, 2018	mnicolich	-
Osyczka_function	Apr 11, 2018	mnicolich	-
re7y_function	Apr 11, 2018	mnicolich	-

BinKorn_function

DETAILS HISTORY

Creator
mnicolich

Created
Apr 11, 2018, 3:55:33 PM

Size
0 Bytes

Tags
MultiObj Constrained Math

Description
2 objectives, 2 inputs, Input constrained, many imported tables

Linked to
Not linked

Metadata
+ Add Metadata

Scenario

Process Automation Expert

Analysis Model
Preparation

Workflow Preparation

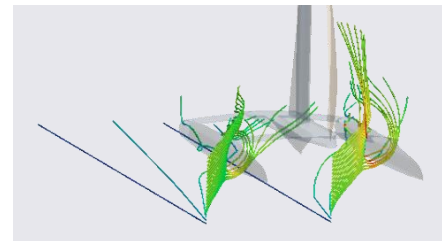
Run Analysis

Analyze Data

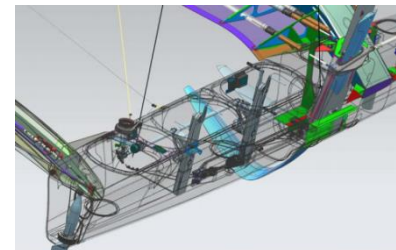
Metamodel Creation



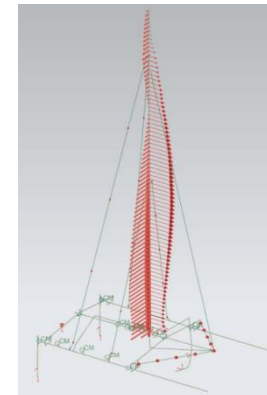
Same product:
Many simulation
processes



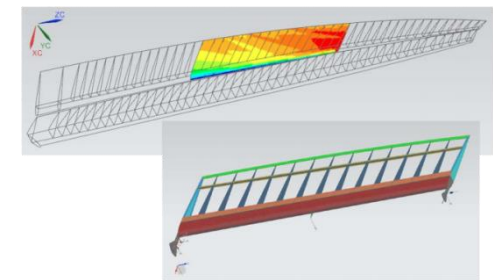
Hydrofoil Systems



System & Control



Structural
Response



Wing Flap

INTEGRATION & PROCESS AUTOMATION

Powerful Workflow

Streamline and automate your engineering process within an integrated workflow.

Increase Efficiency

seamlessly integrate third-party solvers into a unique, automated workflow.

Save Time

automatically run repetitive simulations and avoid the process of manually combining the output from multiple applications.

The screenshot displays the modeFRONTIER 2018R1 software interface, titled "opennFOAM15_ssh_cluster.prj". The interface is divided into several sections:

- Top Bar:** Includes navigation icons (Home, Workflow, Run, Design Space) and a toolbar with various workflow management tools like "Disable Edit Mode", "Customize Interface", "Paste", "Copy", "Delete", "Workflow Wizard", "Data Wizard", "Subsystem", "Convex Hull", "Link Knots", "Distribute Nodes", "Align Nodes", "Print", "Help", "Run Project", and "Stop Project".
- Left Panel:** A "Node..." panel with tabs for "All Nodes" and "Favorites". It includes a search bar "Find node" and expand/collapse options. Below are categorized icons for "Script Nodes", "CAD Nodes", "CAE Nodes", and "Networking Nodes".
- Central Canvas:** A detailed workflow diagram showing a sequence of operations: "hedulingStart [NSGA-II]" leads to "queue_start", "CATIA", "Switch", "ICEM", "SSH", "runMacro", "mesh", "queue_end", "move_results", "transf_vtk", "CFDOutput", "deltap", "vel_unif", "replay_icem_rpl", "geometry", "flag_intersection", "mass", "TransTensIn", "TransTensOut", "tensin", and "tensOut".
- Bottom Panel:** A table for defining variables and constraints.

	Name	Type	Default Value	Expression	Lower Bound	Upper Bound	Central Value	Delta Value	Base	Step	Arrangement	F
1	tensOut	Variable	0.0		1.0	100.0	50.5	49.5	100	1.0	Ordered	0.00
2	tensin	Variable	0.0		1.0	100.0	50.5	49.5	100	1.0	Ordered	0.00

Ready | Grid status: not available | Mode: EDIT



Simulation Process Automation

The modeFRONTIER workflow guarantees formalization and management of all logical steps of an engineering process. Its powerful integration capabilities allow product engineers and designers to **integrate and drive multiple Computed Aided Engineering (CAE) tools**.

Application Nodes



Script Nodes



CAD Nodes



CAE Nodes



INTEGRATION NODES

modeFRONTIER offers over **40 direct integration nodes** to couple with the most popular engineering solvers, in which communication is guaranteed by APIs or automatic file exchange. Wizard-style tools are available for building a bridge to any commercial or in-house codes.

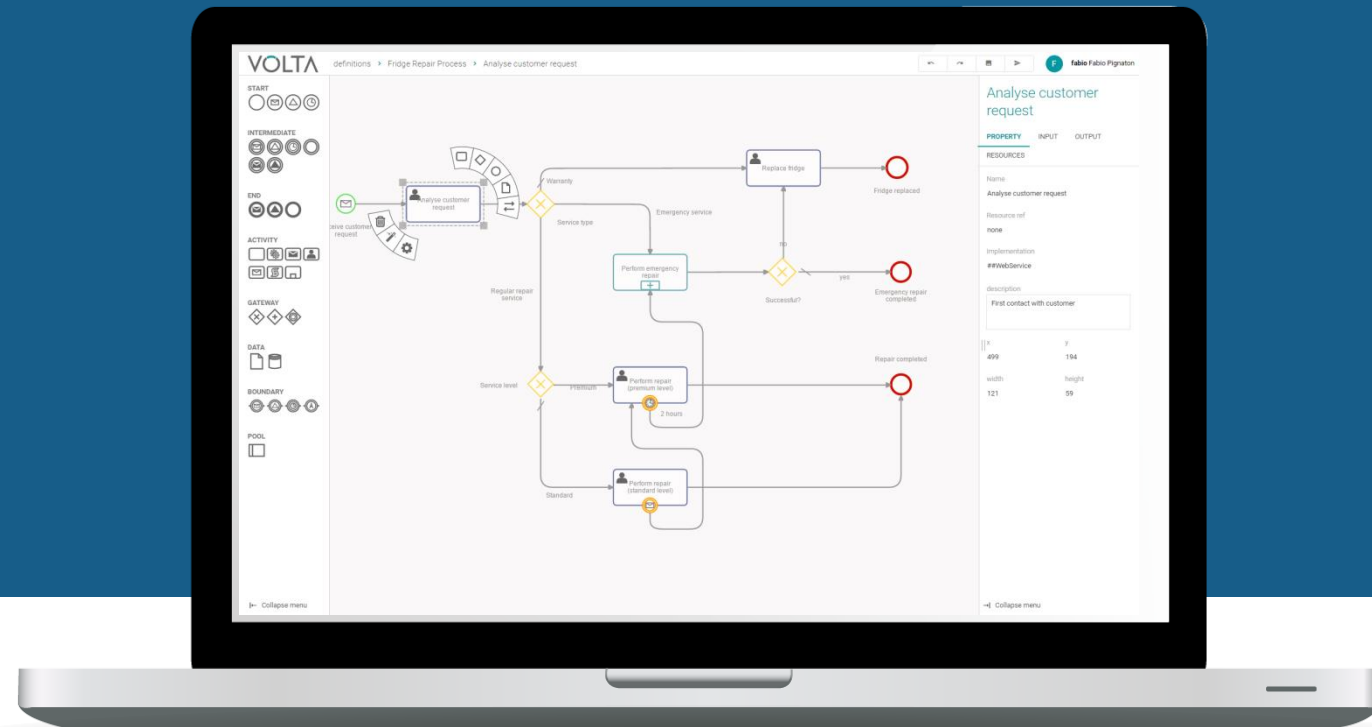
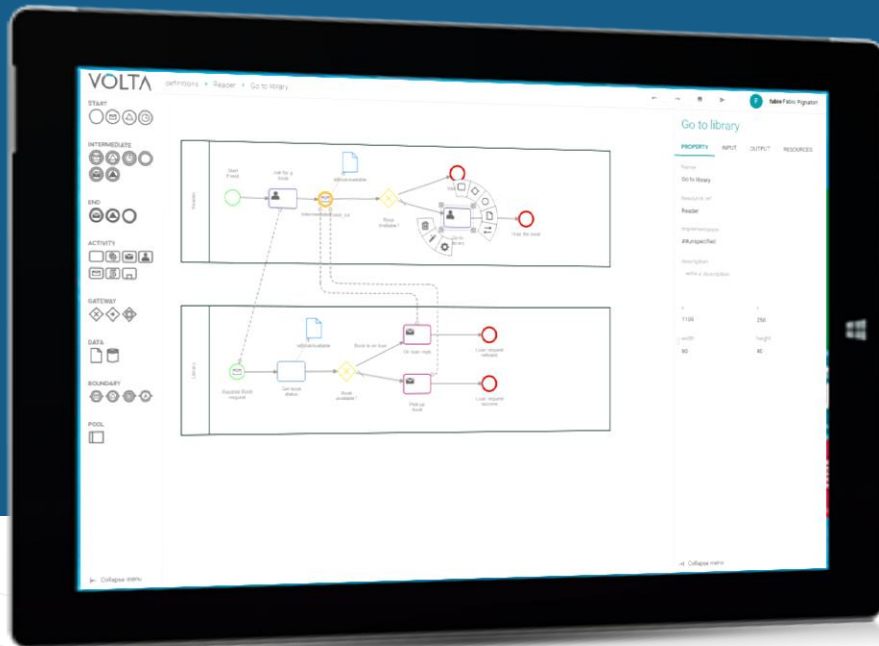
FULL LIST ON
esteco.com





COMING | Web based process editing

From BPMN OMG Standard a fully interactive web-based workflow
Extremely powerful collaborative process editing & management



Scenario

Analysis Model Preparation

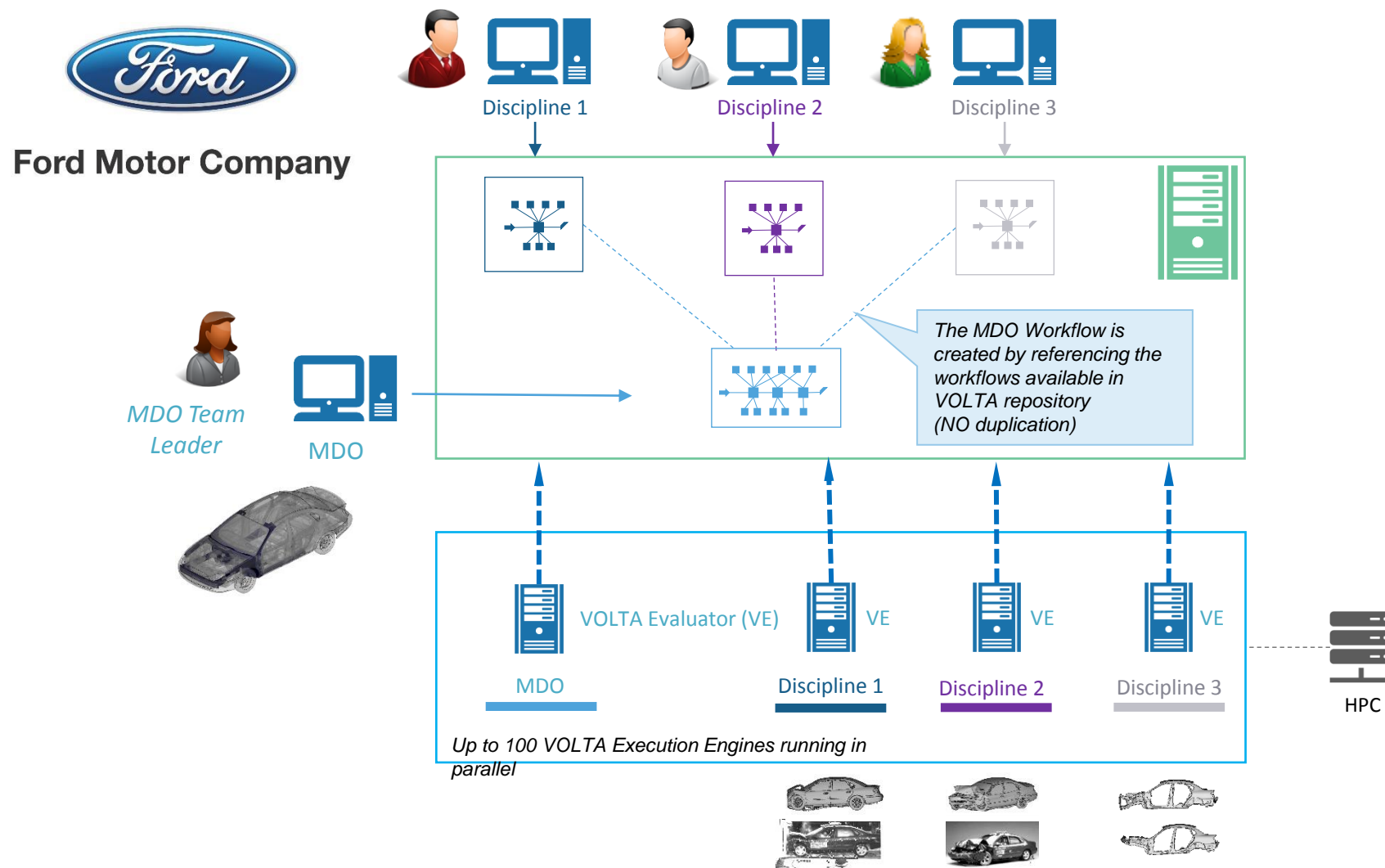
Workflow Preparation

Run Analysis

Analyze Data

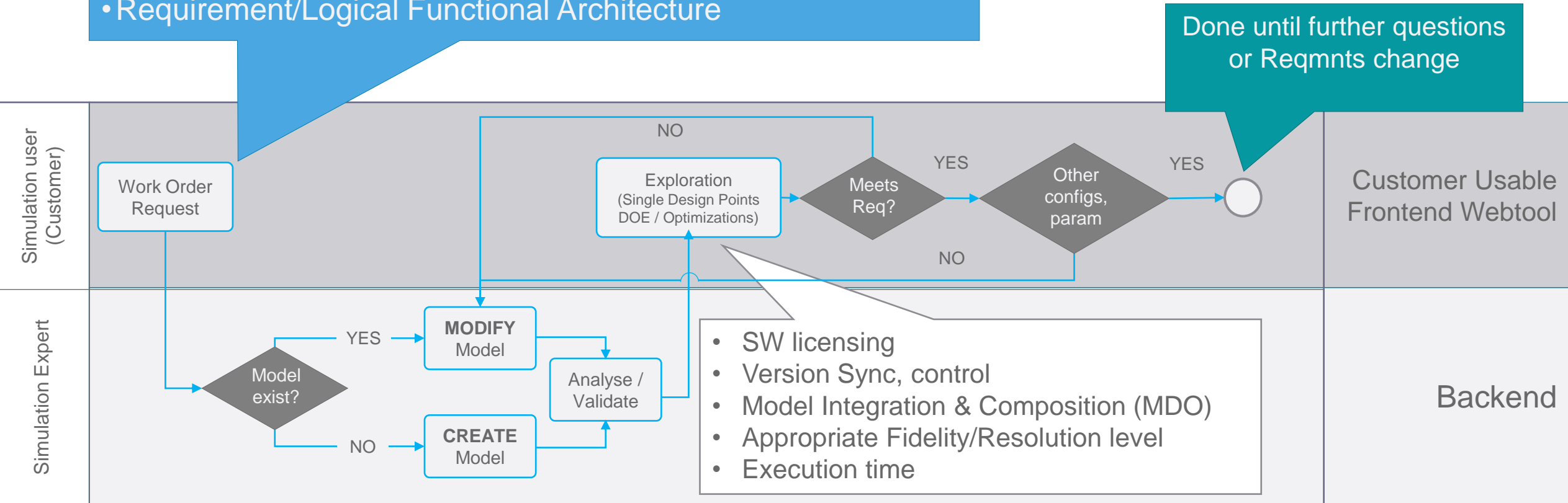
Metamodel Creation

Simulation User



>> Democratizing Simulation

- Fitness functions – no time for manual judgement during optimization
- Parameters ranges
- Requirement/Logical Functional Architecture



DISTRIBUTED EXECUTION

Leverage Corporate Assets

Balance workloads, minimize downtime and integrate different OS environments

Flexible and Secure

multi-core workstations, HPC clusters and public clouds, while ensuring respect of security standards.

Ease IT Management

manage different resource environments and deliver high computational power in the hands of design teams.

The screenshot displays the VOLTA web interface for a completed optimization session. The main heading reads "OPT_test_ENA-3065 is completed" with the subtitle "high fidelity simulation". The interface is divided into several sections:

- OVERVIEW** (selected):
 - SUMMARY**: Creator (bpogace), Created (May 4, 2018, 4:26:43 PM), Tags (sobol, moga_ii, all_in_one, optimization, workflow_based), Description (No description).
 - CONFIGURATION**: Model (high fidelity simulation v2), Variables (2), Constants (0), Objectives (2), Constraints (2), DOE (Sobol), Scheduler (MOGA-II), Wobo (Disabled), Queue (Test queue).
- RESULTS**: A bar chart showing 100% progress. Below it, a table shows: Progress (100%), Designs (1814 of 1814), Feasible (1711), Unfeasible (103), and Error (0). Buttons for "View" and "Post Process" are visible.

>> Asynchronous Distributed Execution

VOLTA Application Layer:

- Administrator defines queues and permissions

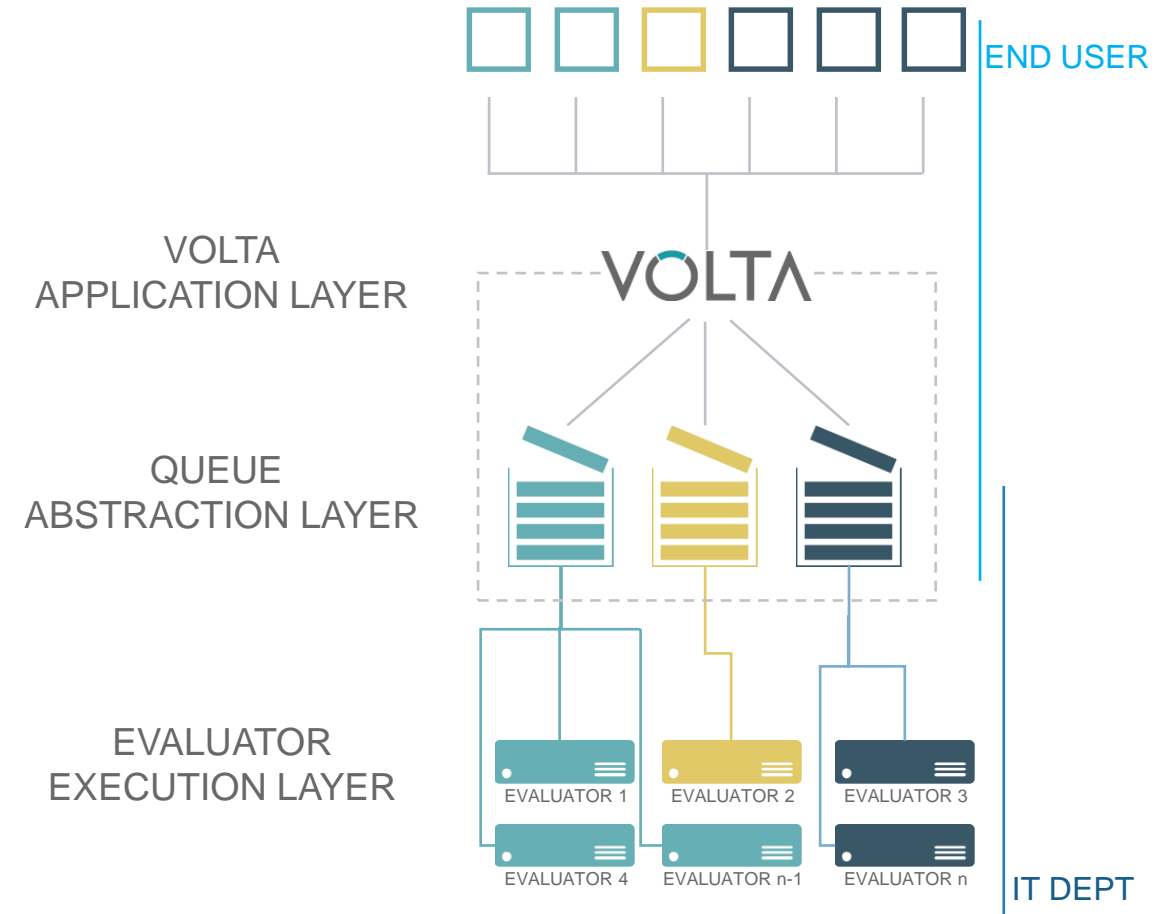
Queue Abstraction Layer:

- Makes the execution Asynchronous
- Guarantees transactions
- Permissions are managed by the Administrator

Evaluator Execution Layer:

- Hides the complexity of the underlying infrastructure
- Scalable of connected Execution Servers running the VOLTA Evaluator

- *Many-to-one* connection



Scenario

Analysis Model
Preparation

Workflow Preparation

Run Analysis

Analyze Data

Metamodel Creation

Data Analyst

PERFORM

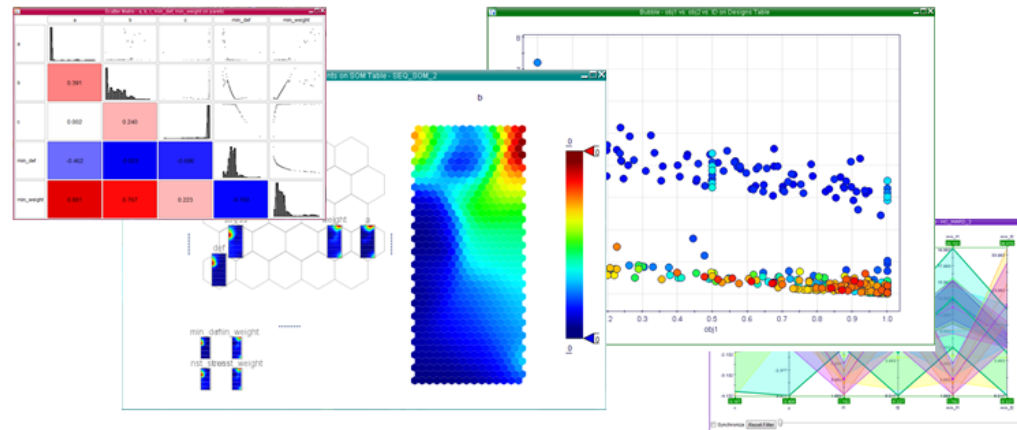
» perform statistical analyses to identify the most important variables a priori and reduce problem complexity

VISUALIZE

» arrange data in a meaningful way, visualize optimization trends and distributions and identify best designs

SPOT

» spot patterns and relationships governing the system response given a particular design configuration



ACCESS
THROUGH

modeFRONTIER

modeSPACE

ENGINEERING DATA INTELLIGENCE

Focus

Quickly identify relevant performance metrics, focus on what is important and make better decisions, faster.

Go collaborative

Stay on track with other experts working on your engineering problem - compare, validate and collaboratively decide on design solutions.

Understand

Turn data into valuable insights and propel your innovation process.

The screenshot displays the VOLTA software interface for a session titled "OPT_test_ENA-3065 is completed". The interface is divided into several sections:

- Header:** "VOLTA SESSION" with a search bar and navigation icons.
- Navigation:** "OVERVIEW", "EVENTS", and "RESULTS" tabs.
- SUMMARY:**
 - Creator: bpogace
 - Created: May 4, 2018, 4:26:43 PM
 - Tags: sobol, moga_ii, all_in_one, optimization, workflow_based
 - Description: No description
- CONFIGURATION:**
 - Model: high fidelity simulation v2
 - Variables: 2, Constants: 0, Objectives: 2, Constraints: 2
 - DOE: Sobol, Scheduler: MOGA-II
 - Wobo: Disabled
 - Queue: Test queue
- RESULTS:**
 - Progress: 100%
 - Designs: 1814 of 1814
 - Feasible: 1711, Unfeasible: 103, Error: 0
 - Buttons: View, Post Process

Scenario

Analysis Model
Preparation

Workflow Preparation

Run Analysis

Analyze Data

Metamodel Creation

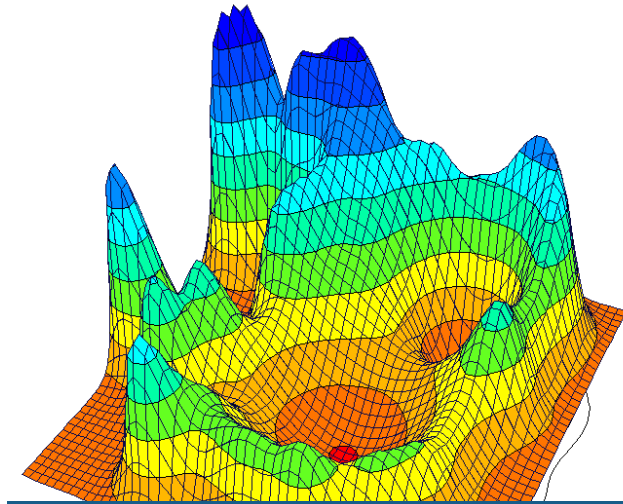
Exportable Mathematical Model

HOW DOES IT WORK?

1. **RSMs** are **trained** from an available database of real designs and validated one against another.

2. The best model is used to **compute** the outputs of the system; this process is called **virtual optimization**.

3. The best designs obtained through virtual optimization are then **evaluated by the real solver**

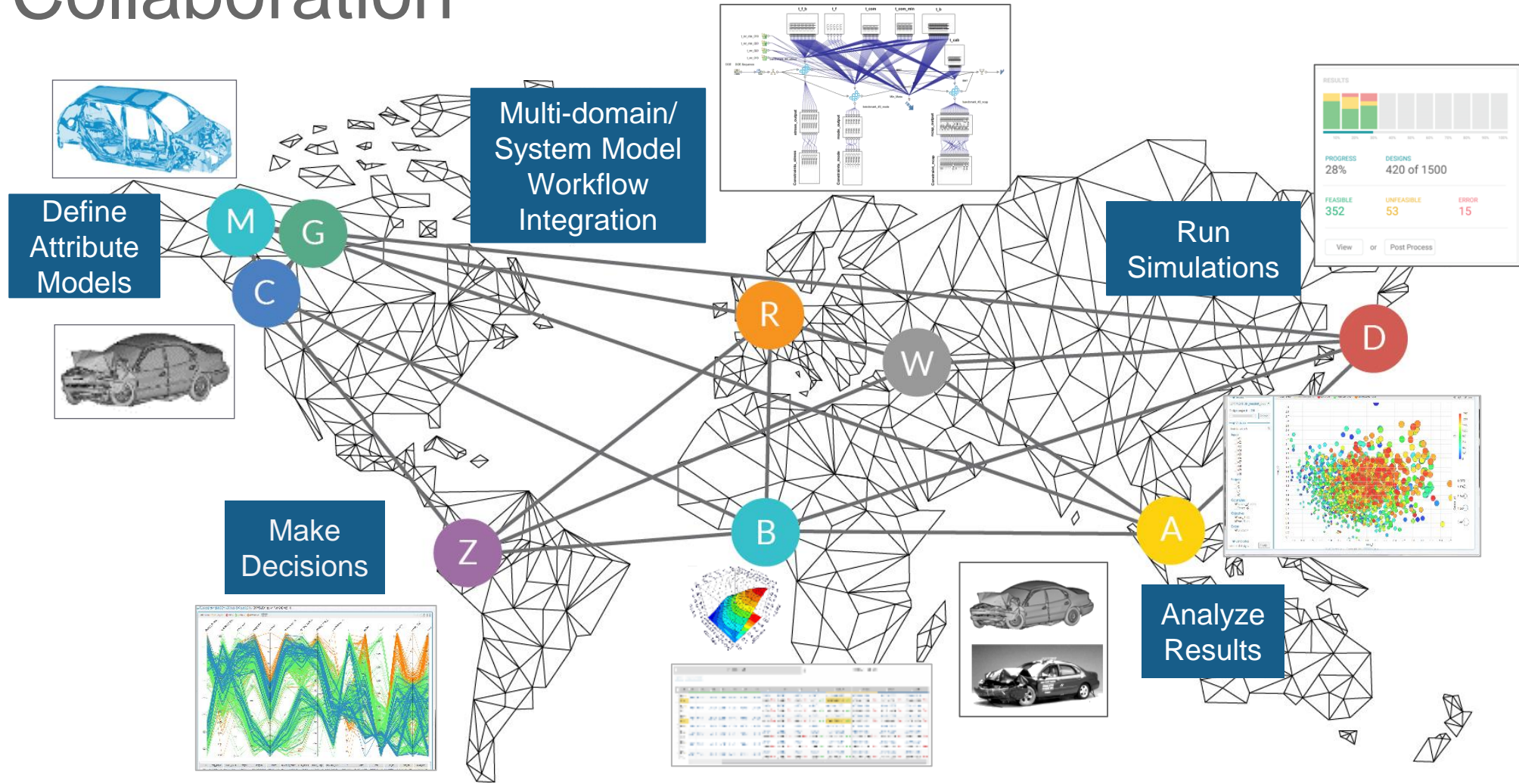


MAIN ADVANTAGES

- perform thousands of design evaluations in short time
- accelerate the optimization step
- use small amounts of data efficiently
- smart exploitation of available computational resources



Collaboration



VOLTA is a web platform for multidisciplinary business process optimization and simulation data management





Value, Impact and Benefits

Value

- Foundation for the next generation engineering design process

Impact

- Enterprise MDO is a key GPDS enabler

Benefits

- Achieve product performance improvement
- Achieve balanced, data-driven, global design process
- Reduce engineering & product development turnaround time
- Break time, physical, and organizational boundaries through internet and enable effective communication
- Greatly improve integration capability of engineering process
- Help to execute 24/7 global partner strategy





Summary – VOLTA Benefits

- **for the Company**
 - Simplified, multi-user repeatable design process
 - Collaboration between teams and organizations
 - Common Repository for sharing knowledge and best practices
 - Compliance with security and data privacy policies
- **for Engineers**
 - Better organized and more efficient environment for simulation and optimization
 - Trace results to models and simulation parameters
- **for Managers**
 - Easier and simpler access to results
 - More informed and faster decision making





Thank you for your attention!

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EXPLORE DESIGN PERFECTION

