



# Scaling MDO enterprise-wide with VOLTA SPDM

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VOLTA Product Manager

“To achieve a high level of digital engineering maturity, organizations must be able to capture and automate their business, engineering workflows, and processes. And, they must be able to access, connect, and use their data effectively.

**Aerospace Industries Association (AIA)**

Emerging Needs and Considerations for Digital Engineering Software Tools, 2022.



# Challenges in the Model-based design process

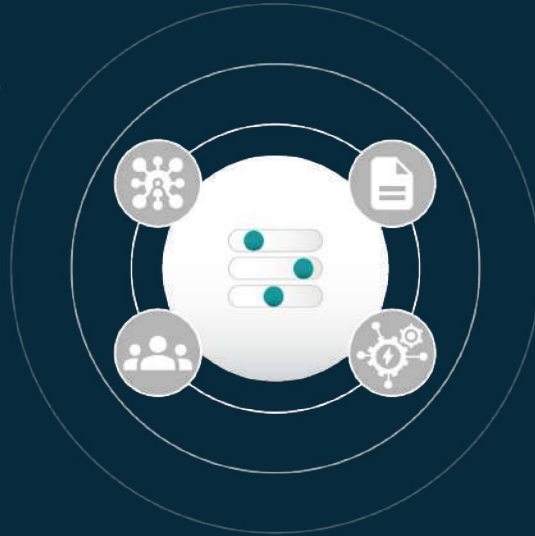
- Products are complex system-of-systems
- Integration of multiple engineering disciplines
- Large number of simulation tools
- Collaboration among subject matter experts
- Geographically dispersed workforce and compute infrastructure



# Simulation operational challenges

Connect simulation data to product digital thread

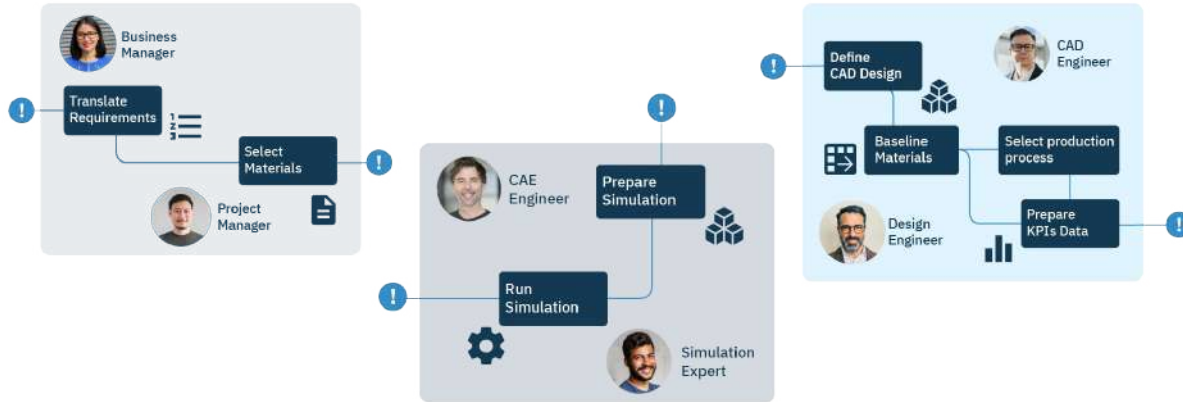
Enable non-simulation experts to perform routine analysis



Version management and traceability of simulation data

Deliver ready-to-use CAE workflows

# Teams work in silos



- Inefficient collaboration between departments
- Undefined engineering design processes
- Fragmented access to lots of vendor-locked tools
- Access to simulation data is limited to domain experts

# Reasons behind low adoption of SPDM systems



## Capabilities

Low levels of CAE workflow automation and design optimization.

Embedded SPDM in PLM ecosystems takes time (customization efforts).



## People

Encourage use of a common SPDM platform instead of in-house solutions.

Maintain adoption levels.



## Company culture

SPDM ROI takes resources, effort and time.

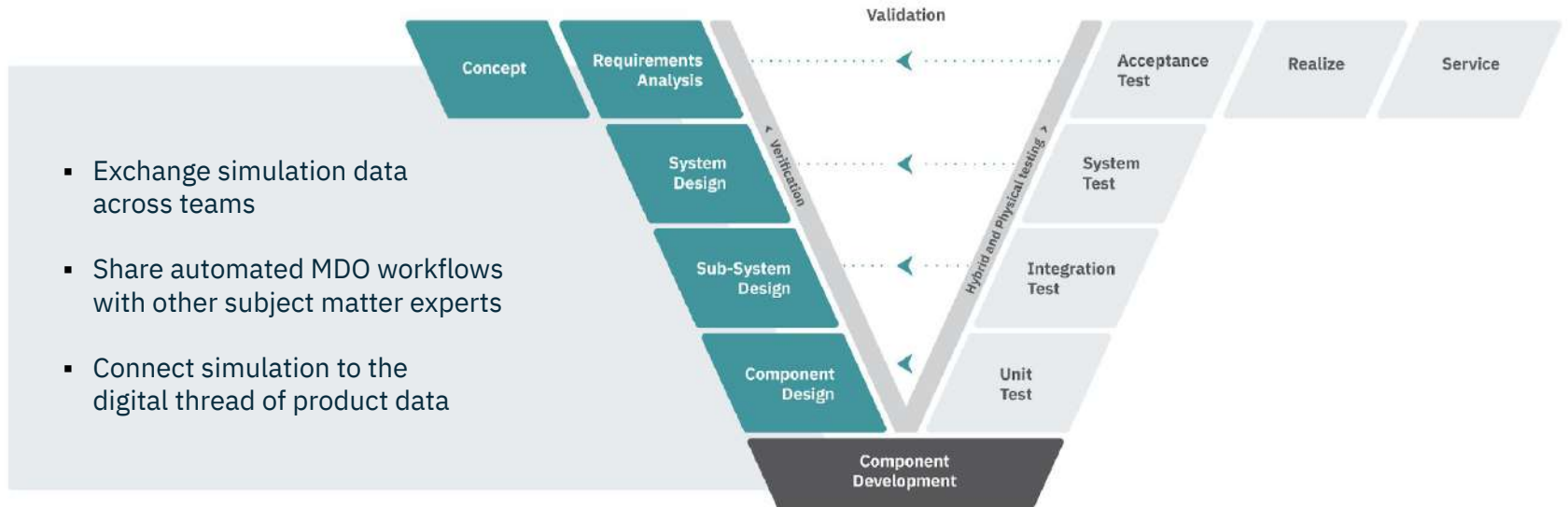
Management must be on board.

Mindset needs to change:  
*“We have always done it this way”.*



# Imagine an SPDM solution that...

Improves model-based design processes using a collaborative web framework for Multidisciplinary Design Optimization (MDO).



# ESTECO VOLTA

The digital engineering platform for SPDM and Design Optimization.



Take full control over the engineering design process, from simulation workflows to high-level business decisions.





# ESTECO VOLTA is unique

- Rapid deployment: standalone or cloud-native
- Vendor-neutral SPDM ecosystem
- Integrated design optimization
- Web environment for global collaboration
- World-class engineering support



# What VOLTA can do for your organization



Web-based collaborative platform designed for simulation-driven product development.



# Simulation Process and Data Management (SPDM)



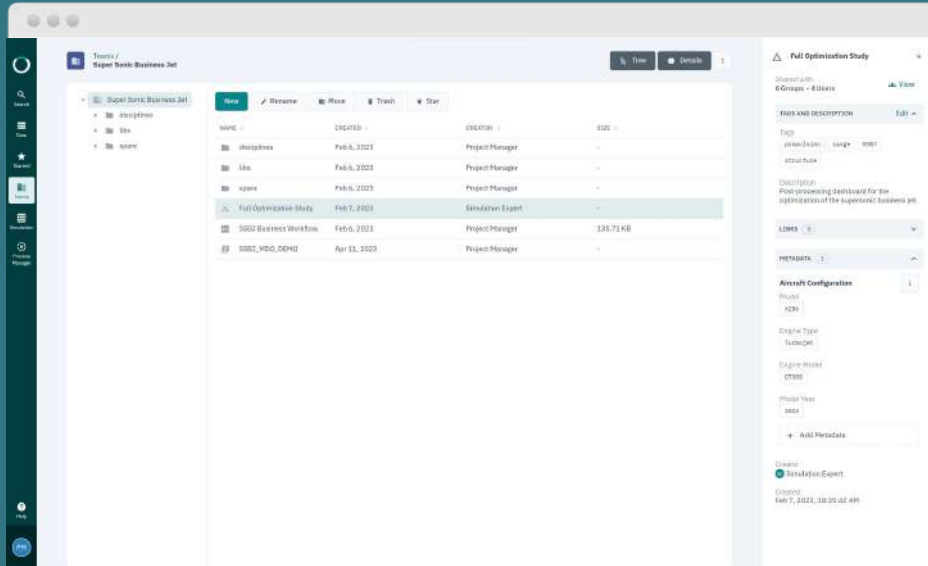
VOLTA SPDM technology gives you an authoritative source of truth for all simulation data.

Business Process Management (BPM) capabilities enable you to orchestrate design processes.



# VOLTA Data Manager

Capture, version and share simulation data securely on the web.

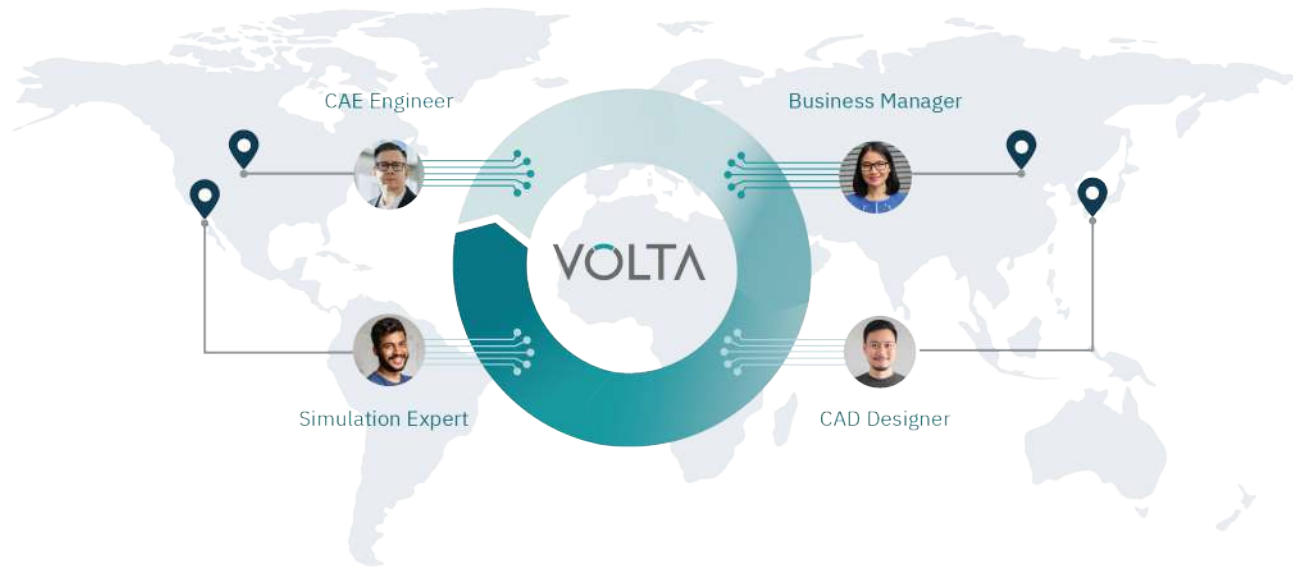


- Keep track of all your data, CAD/CAE models, simulation workflows and design space exploration studies
- Set permissions to access files and protect company IP
- Access analysis data anytime, anywhere, and from any device



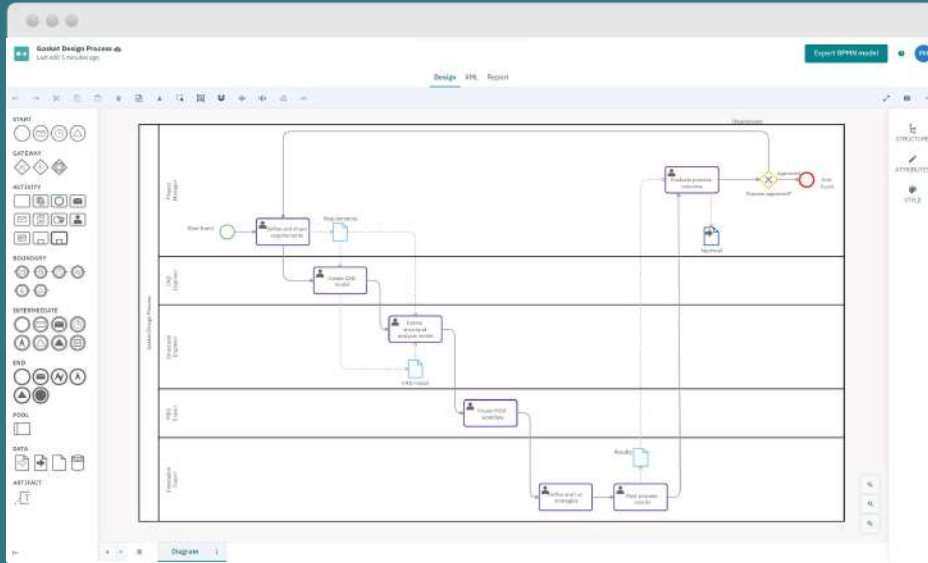
# Make simulation accessible to everyone

Empower collaboration across your organization to accelerate engineering design process.



# VOLTA Modeler

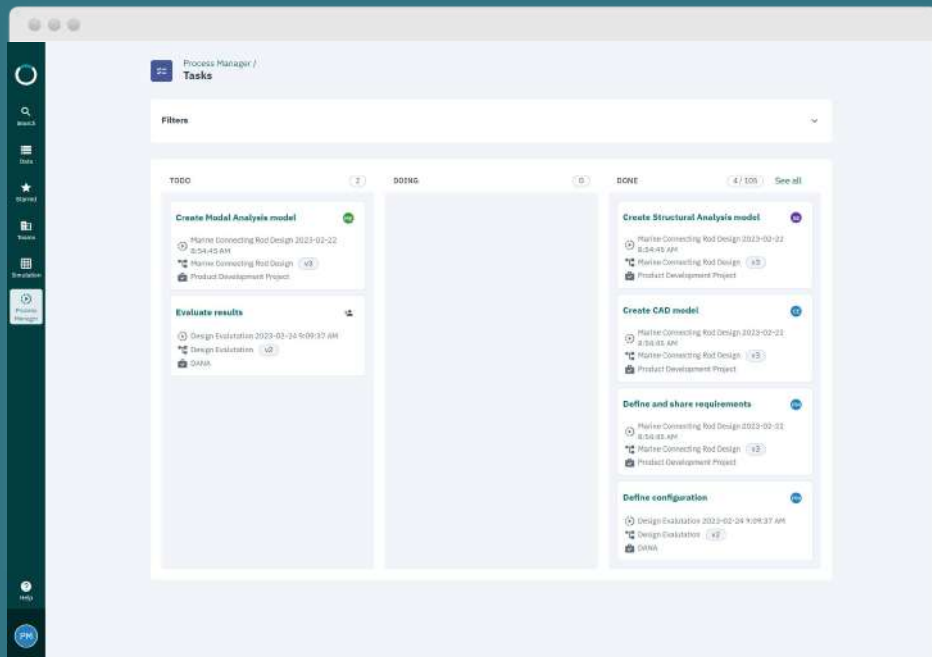
Map and standardize engineering design processes.



- Map with BPMN 2.0 workflows to formalize existing practices into documented processes
- Manage people interactions and integrate tasks in executable business processes
- VOLTA Service task: integrate simulation workflows and perform design space exploration studies

# VOLTA Process Manager

Execute engineering design processes.

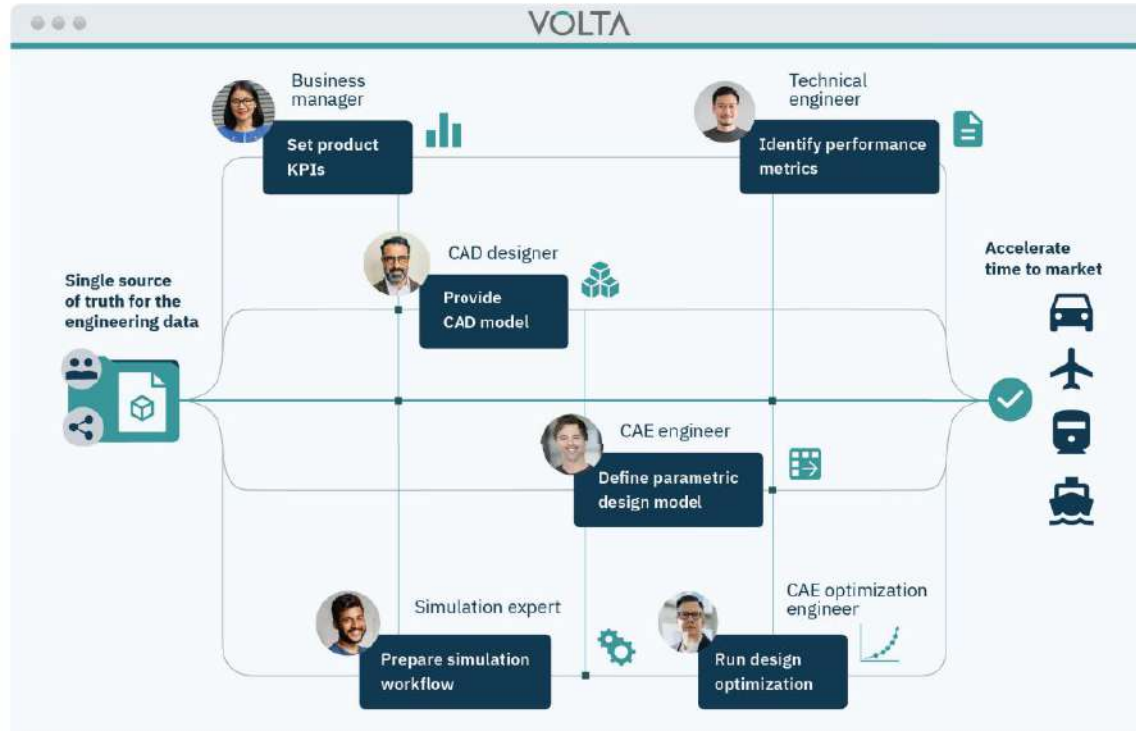


- Run processes created in the VOLTA Modeler environment
- Manage process sequence and deliver tasks to the right resource at the right time using a Kanban board
- Ensure full traceability to keep track of every action performed during execution



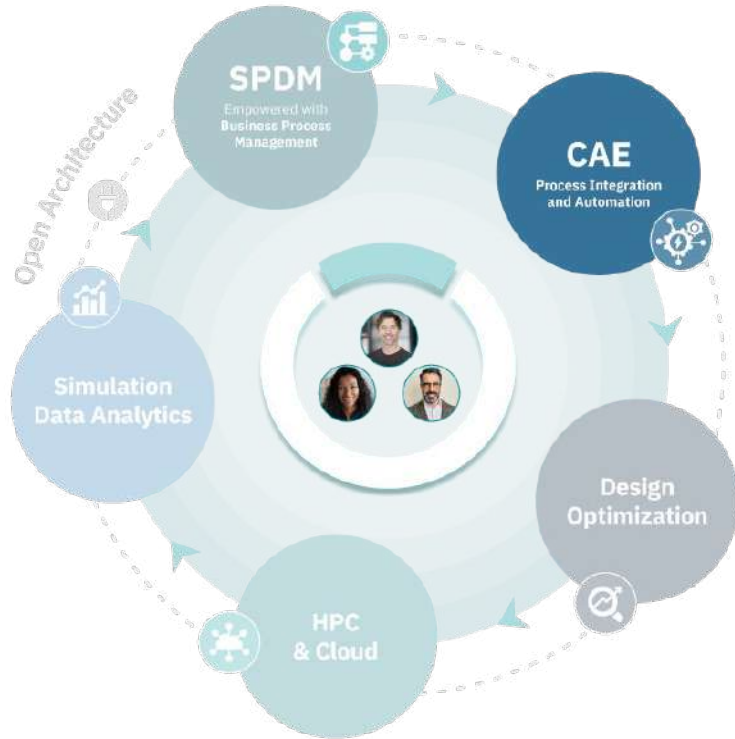
# Maximize the enterprise-wide flow of data

Information flows across teams, reaching the right people at the right time.





# Simulation Process Integration and Automation

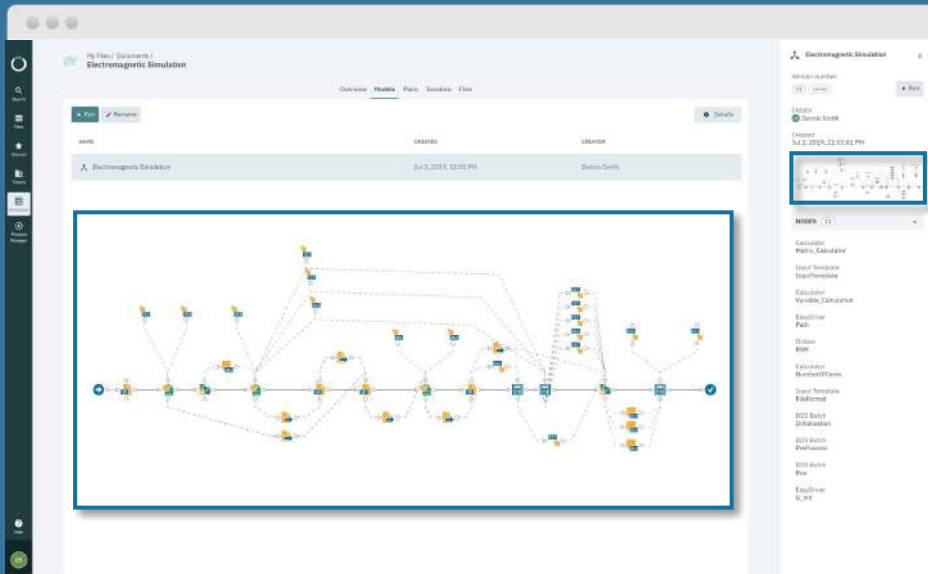


VOLTA vendor-neutral framework to manage multidisciplinary design analysis from a single automated simulation workflow.



# Leverage ESTECO modeFRONTIER technology

Facilitate design exploration or optimization studies in VOLTA.

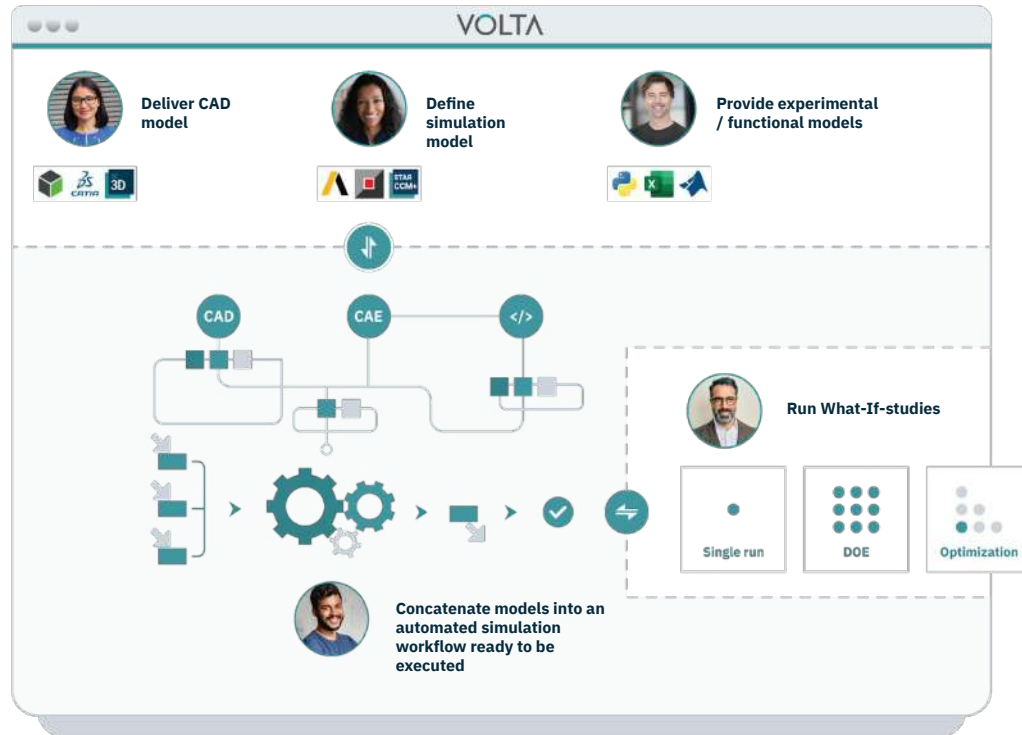


- Integrate any CAD/CAE or in-house software into modeFRONTIER simulation workflows
- Seamless integration between modeFRONTIER and VOLTA
- Upload multidisciplinary workflows to VOLTA and perform system level design space exploration studies



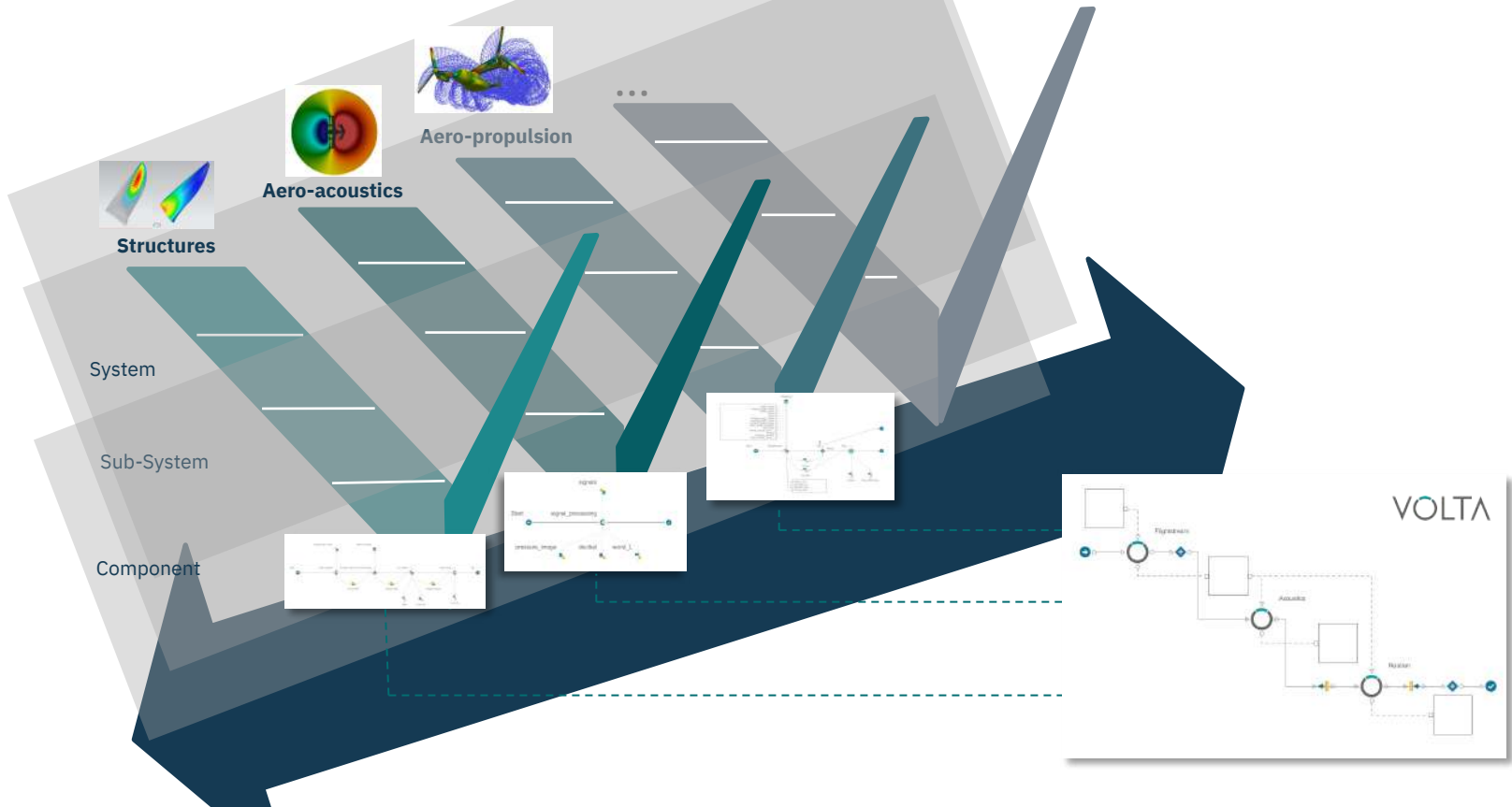
# Democratize multidisciplinary simulations

Streamline expert simulation work and deliver automated workflows re-usable by a wider audience of engineers.



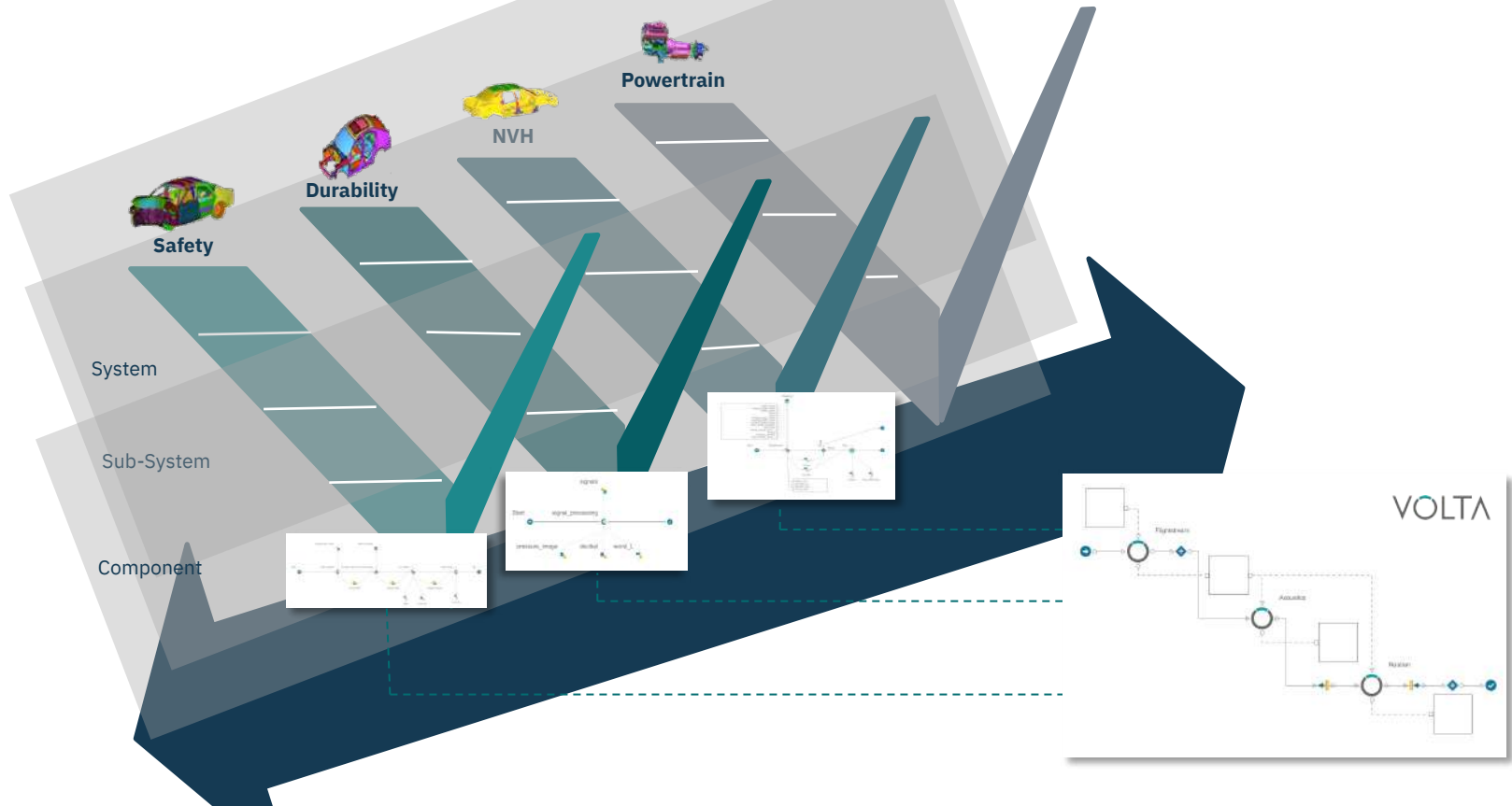
# Typical MDAO scenario (in multiple V-models)

The need for collaboration across disciplines and systems



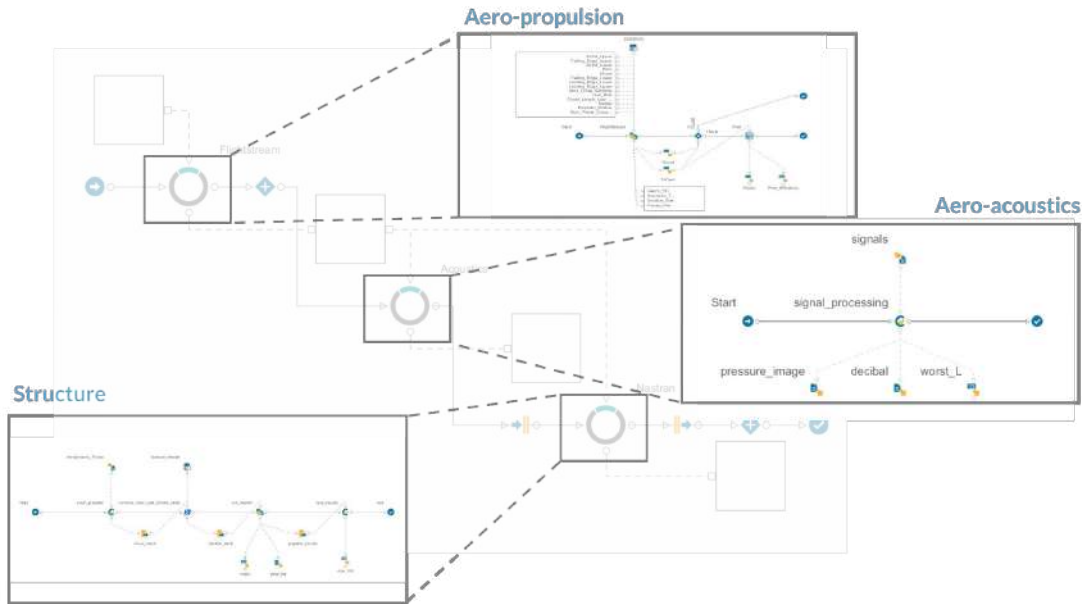
# Typical MDAO scenario (in multiple V-models)

The need for collaboration across disciplines and systems



# MDAO workflow

Ready to be execute in VOLTA to perform MDAO studies



- Use the VOLTA Planner to apply any Design Space Exploration Strategy to MDAO workflows.
- Submit simulations in Distributed Execution mode
- Post-process results in VOLTA Advisor



# Design Optimization

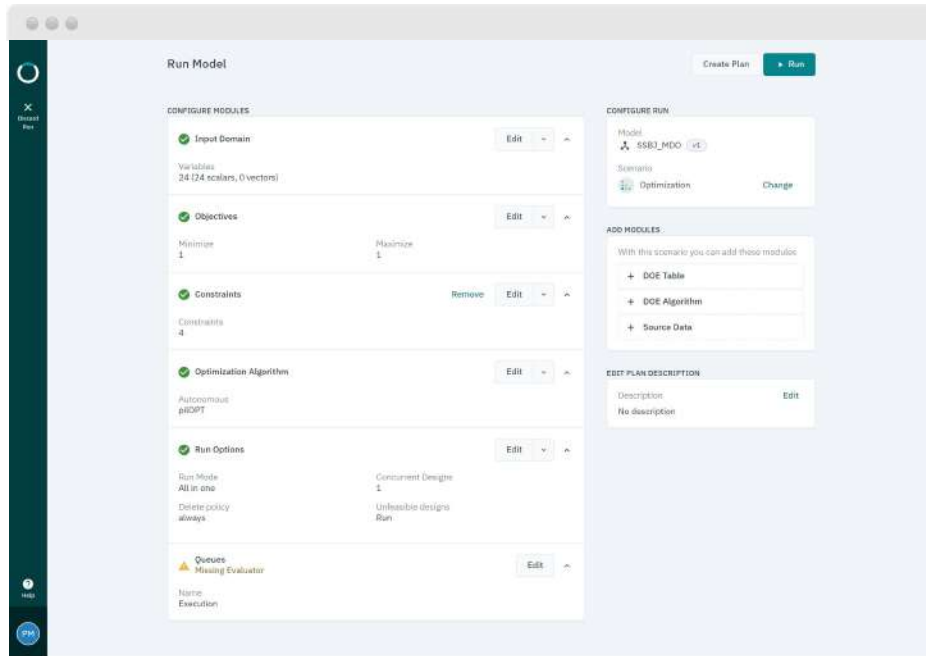


VOLTA is the only SPDM solution on the market that comes with fully integrated, state-of-the-art Design Optimization capabilities.



# Design Optimization

VOLTA Planner: execute MDAO workflows from an intuitive web interface



- Uncouple simulation workflow from design space exploration strategy
- Apply multiple design space exploration scenarios
- Share optimization studies with other team members and enable collaboration





# Democratize design exploration and optimization

Run ESTECO state-of-the-art algorithms in autonomous mode.



Expert or newcomer  
to initially investigate  
the design space

The screenshot shows the VOLTA software interface. At the top, there are two tabs: "GLOBAL SEARCH" and "LOCAL REFINEMENT". Below these are four columns of optimization algorithms:

HEURISTIC	MULTI-STRATEGY	DERIVATIVE FREE OPTIMIZATION	GRADIENT-BASED
SIMULATED ANNEALING	HYBRID	POWELL	CLASSICAL SQP METHODS
EVOLUTIONARY ├── GENERIC ├── PARTICLE SWARM └── EVOLUTION STRATEGY	FAST piLOPT SANGEA MEGO	SIMPLEX	AFiltersSQP Bounded BFGS

Below the algorithm selection is a slider for "ACCURACY" and "ROBUSTNESS". The main interface is titled "VOLTA" and "Run Model". It has several input fields: "Input Domain", "Objectives", "Constraints", "Optimization Algorithm", and "Queues". A dropdown menu is open for "Optimization Algorithm". To the right, there is a "YourModel" section with a "V1" label and an "Optimization" section. A circular inset shows a scatter plot of optimization results, with a color scale on the right ranging from 0.0000 to 0.0001.

**Manual**  
Set all parameters

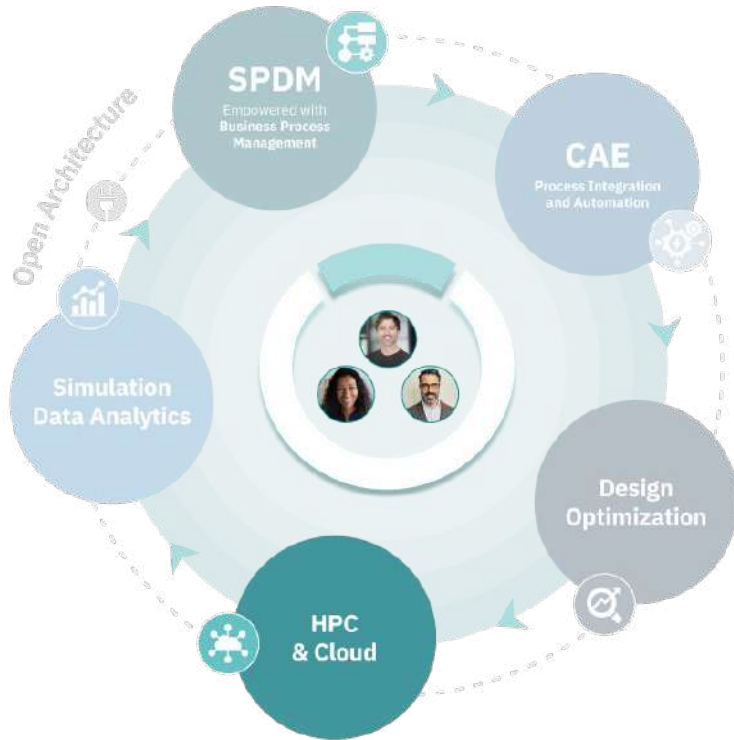
**Self-initializing**  
Single parameter

**Autonomous**  
No parameter  
just one click

Algorithm set-up  
Time & Expertise



# HPC & Cloud



VOLTA job scheduling maximizes the use of IT resources by distributing workloads across HPC and cloud environments.

# VOLTA Player

Monitor and manage local and remote computing resources to run complex simulations.



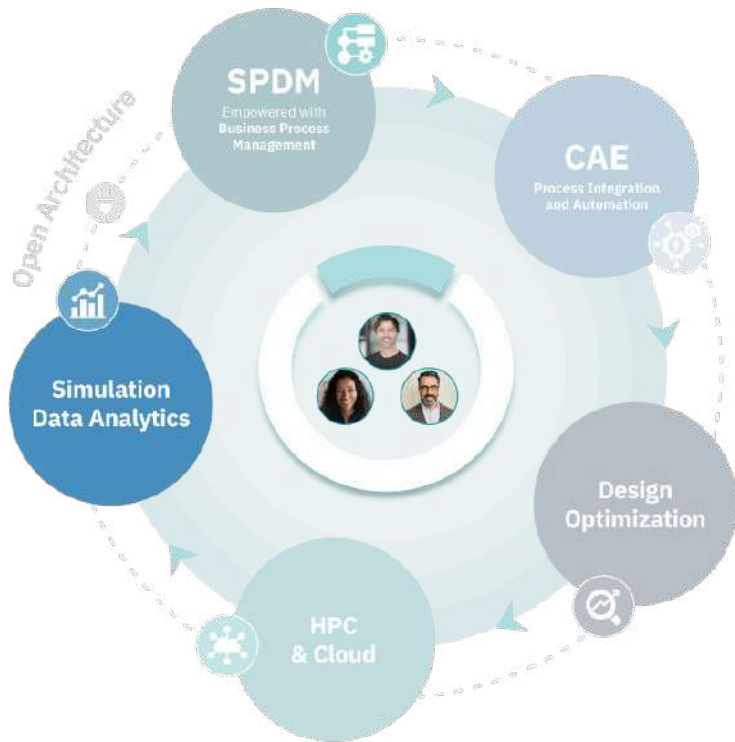
Smart use of computing resources to reduce lead time

Execute simulations in parallel on ICT infrastructures

Exploit multi-core workstations, HPC clusters and public clouds



# Simulation Data Analytics

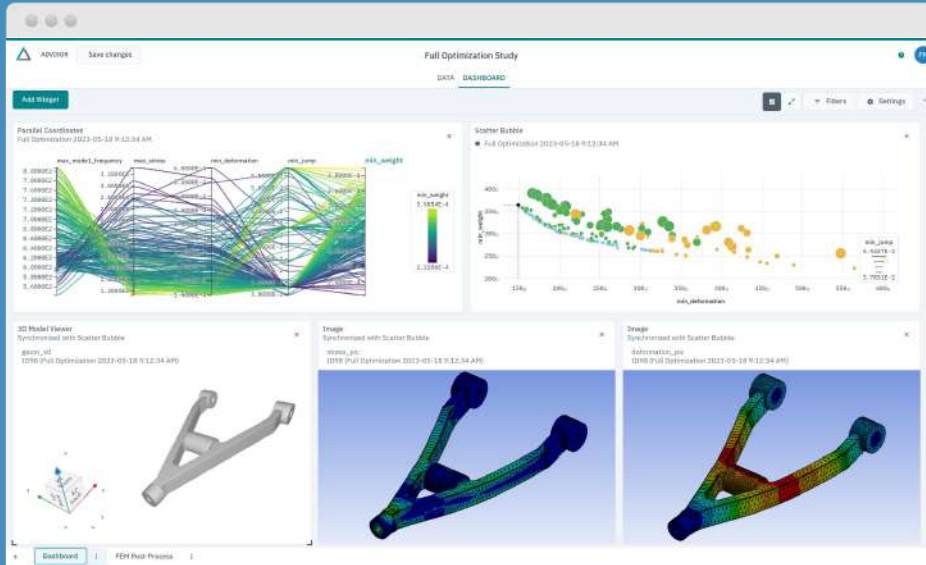


Turn data into actionable insights. Democratize access to product performance metrics and enable collaborative decision making.



# VOLTA Advisor

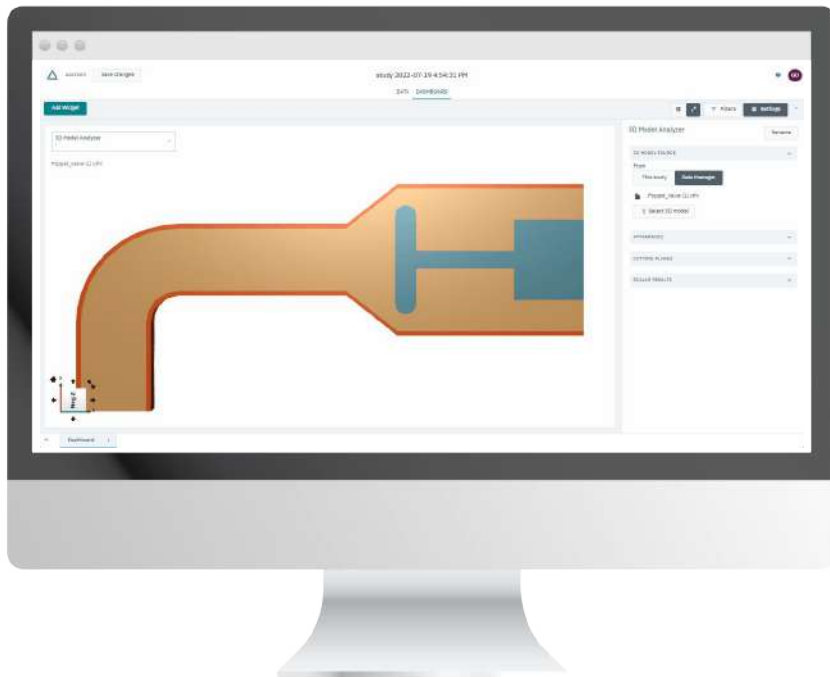
Create post-processing dashboards for analyzing design space exploration studies.



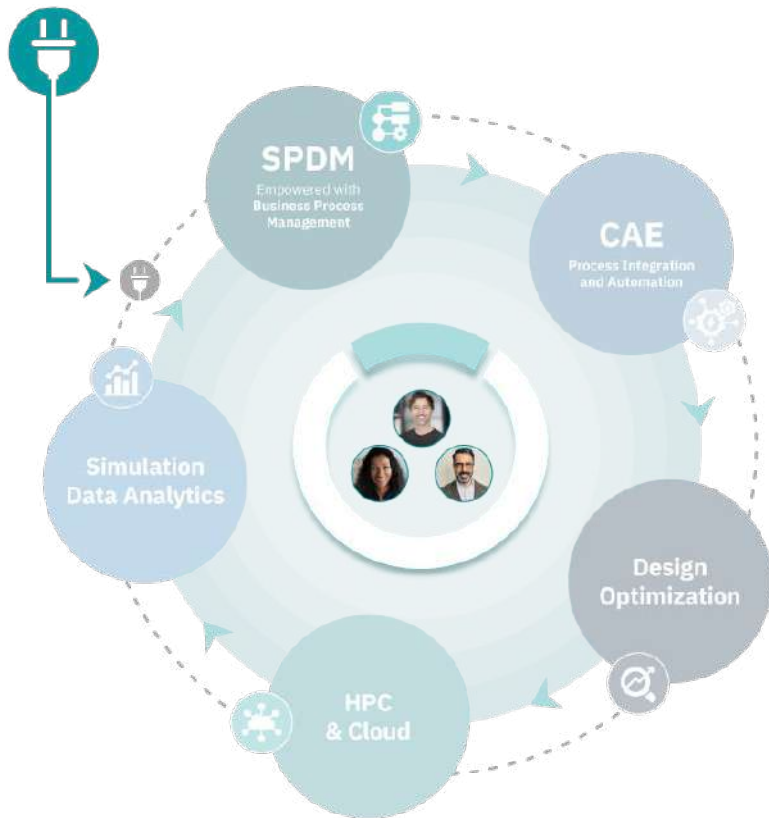
- Interpret simulation data with a wide array of advanced data analysis tools and web-based interactive charts
- Enable multiple stakeholders to predict product behavior and share insights
- Access simulation results and change request in real time

# Seamless 3D CAE visualization

Post-process CAD/CAE models from a web dashboard and share the insights in real-time with other stakeholders.



# Open Architecture

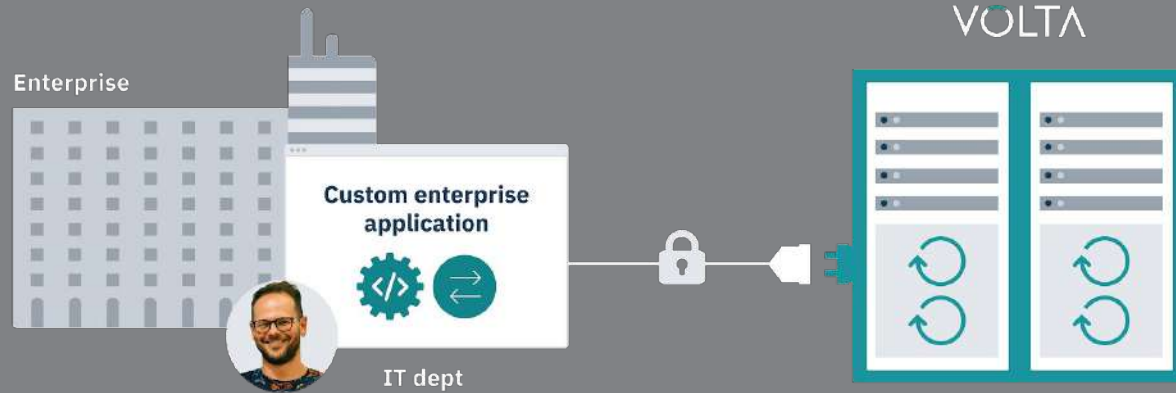


Connect simulation to the digital thread of product data with VOLTA Application Programming Interfaces (APIs).



# Interoperability with other enterprise systems

VOLTA APIs guarantees digital continuity: integration with PLM systems and company's digital thread.



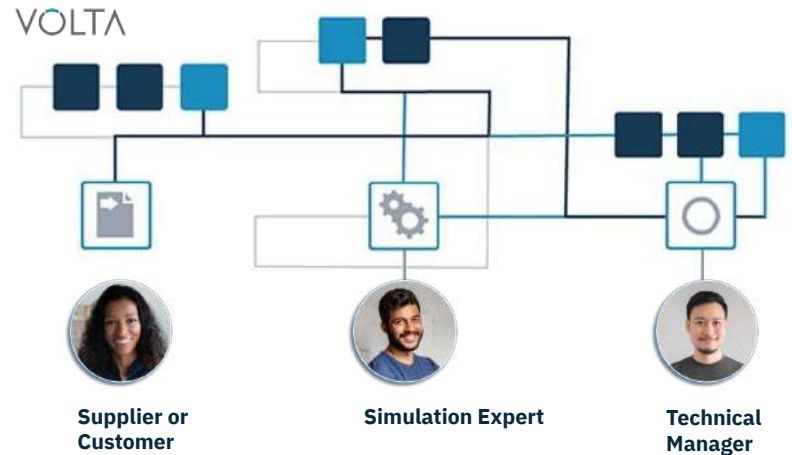


# Extend simulation in B2B or B2C context

Enabling OEMs, suppliers and customers to collaborate with each other in real time

In this scenario, a supplier or customer can:

- Connect to VOLTA and share their simulation models
- Modify, version or update simulation models directly in VOLTA
- Provide the latest simulation model which is automatically used in the MDAO workflow



# VOLTA API: verticalizations enabler

No IP-sharing requirements for customer's custom-built extensions

## Stable

REST, JSON format for request, response bodies and errors

## Documented

Documentation with changelog

## Maintained

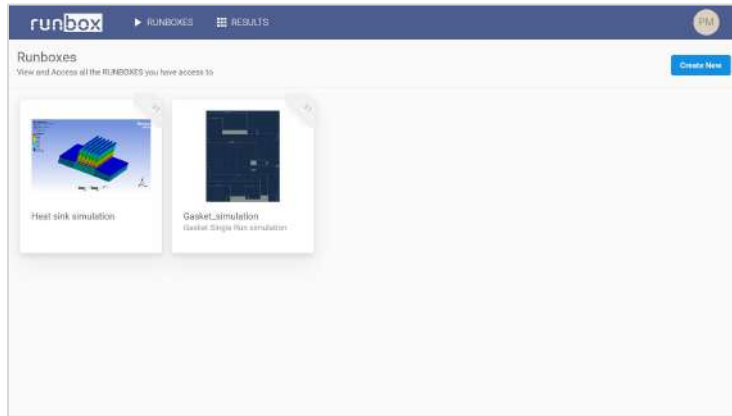
At least for

- 4 releases or
- 18 months

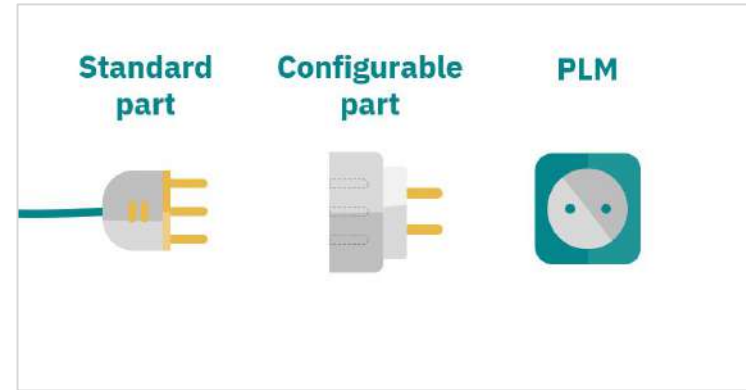


# VOLTA API: verticalization examples

Use VOLTA APIs to interact with VOLTA content and its features.



runbox



VOLTA to PLM Connector

# A future scenario after deploying VOLTA

Multidisciplinary Design Optimization becomes a cross-team effort.

## Wider audience of engineers instead of an “expert-only” exercise

- Benefits from real time access to engineering data and make informed decisions

## From a decision-maker’s point of view

- Simulation experts spend less time on non-value-added tasks
- Business, design and simulation experts verify product requirements
- Data-driven decision making across teams
- Managed cultural change focused on collaboration and sharing
- Maximized impact of simulation and more efficient product design cycle



# Efficient Mission Engineering using VOLTA Simulation Process and Data Management (SPDM)

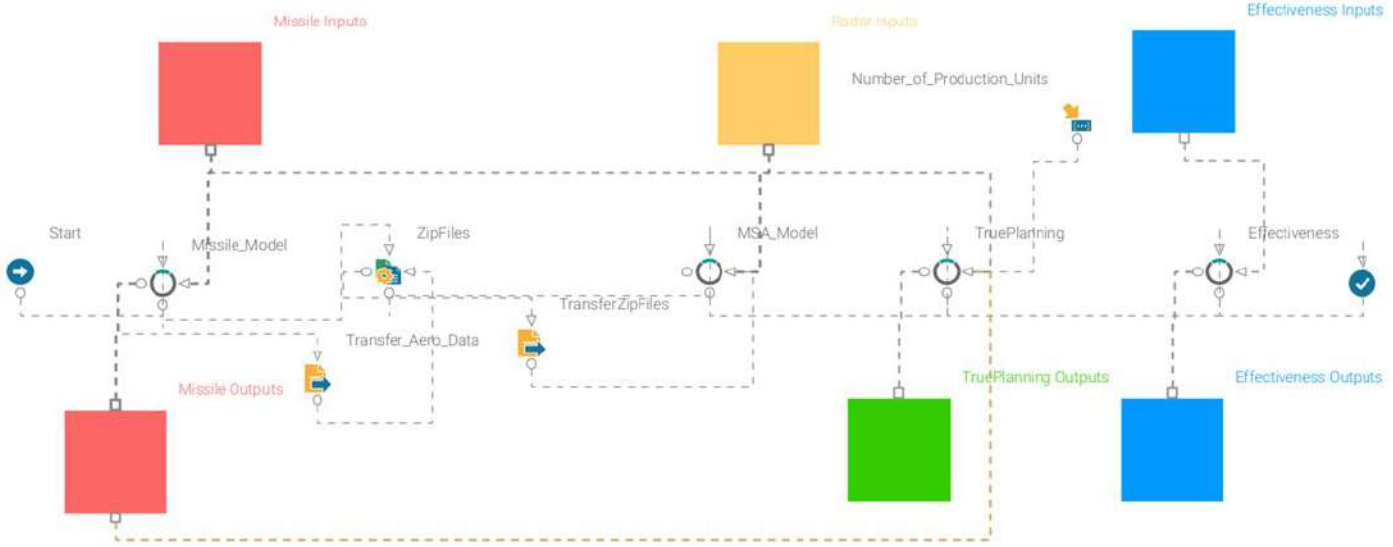
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Raytheon Technologies

# Automated Execution of Workflows using Vetted Disciplinary Models



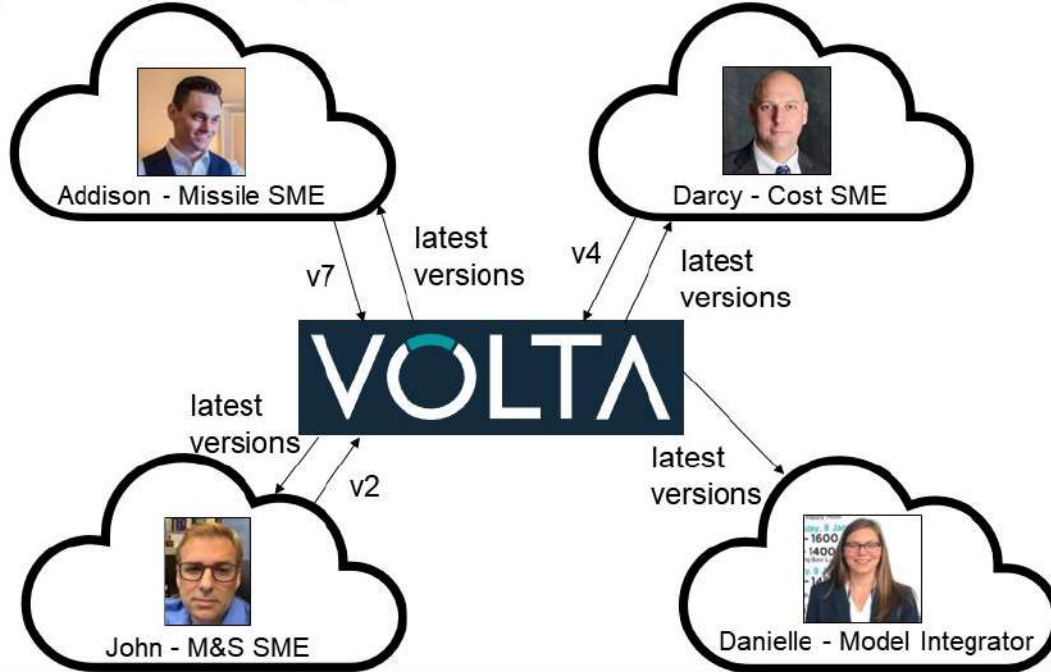
Danielle  
Model Integrator



VOLTA allows collaborative creation of workflows using vetted models developed by SMEs

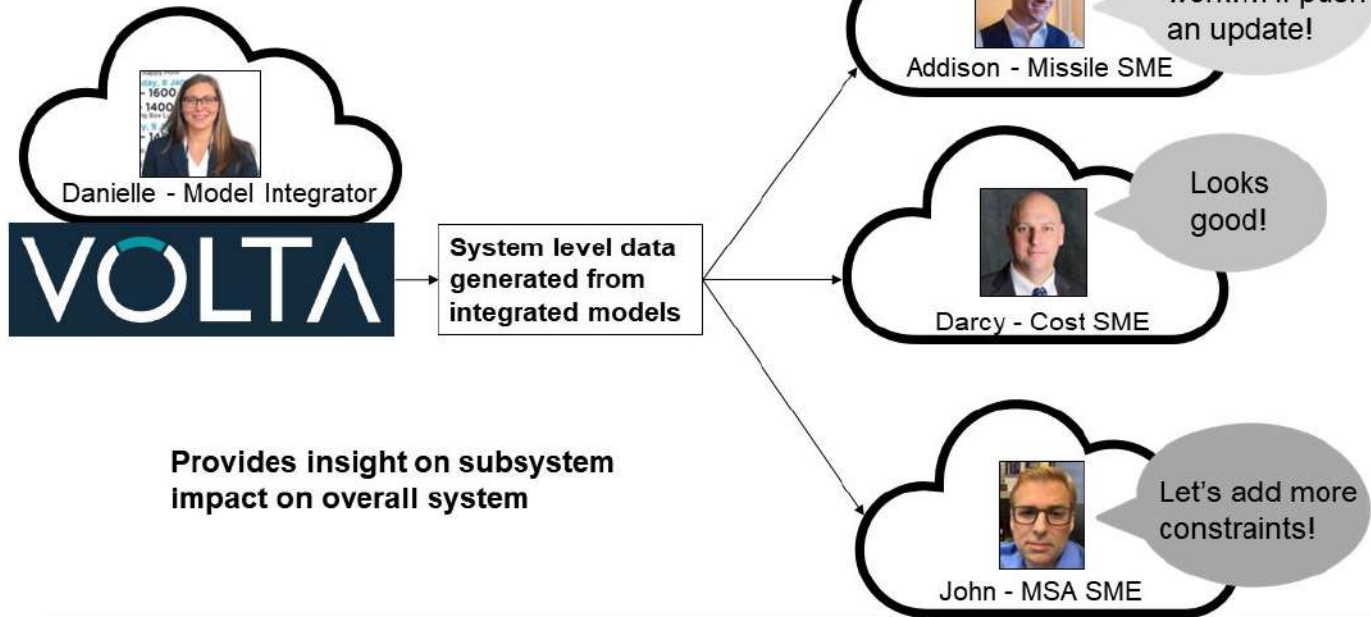


# Summary – Digital Approach With VOLTA



With VOLTA's version control capabilities, model workflows can be easily integrated into larger design space workflows

# Summary – VOLTA Collaboration for Data-Based Decisions



Provides insight on subsystem impact on overall system

Analysis data can be reviewed in one place and can quickly facilitate improvements to models



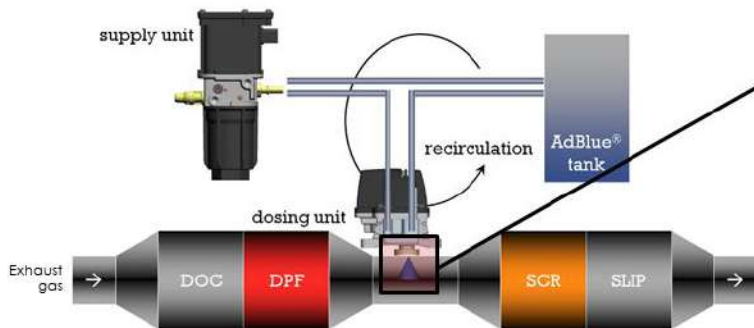
# Development and Democratization of Simulation-Based Swirl Atomizer Development

- **Processes**  
Cummins Emissions Solutions

# Cummins UL2.2 SCR-Dosing System



## Basic principle



DEF: Diesel Exhaust Fluid  
DOC: Diesel Oxidation Catalyst  
DPF: Diesel Particle Filter

SCR: Selective Catalytic Reduction  
SLIP: Ammonia Slip

## Dosing Unit

- Mounts to the Decomposition Reactor
- Cooled by urea recirculation (no additional coolant); heated by electricity
- **Contains pressure-swirl atomizer** Area of focus of this presentation
- Enhanced freeze-resistant components
- Contains injector, temperature and pressure sensors

## Supply Unit

- Mounts to the chassis
- Heated by engine coolant
- Enhanced freeze-resistant components
- Contains optional integrated dosing controls to monitor injector, temperature and pressure sensors



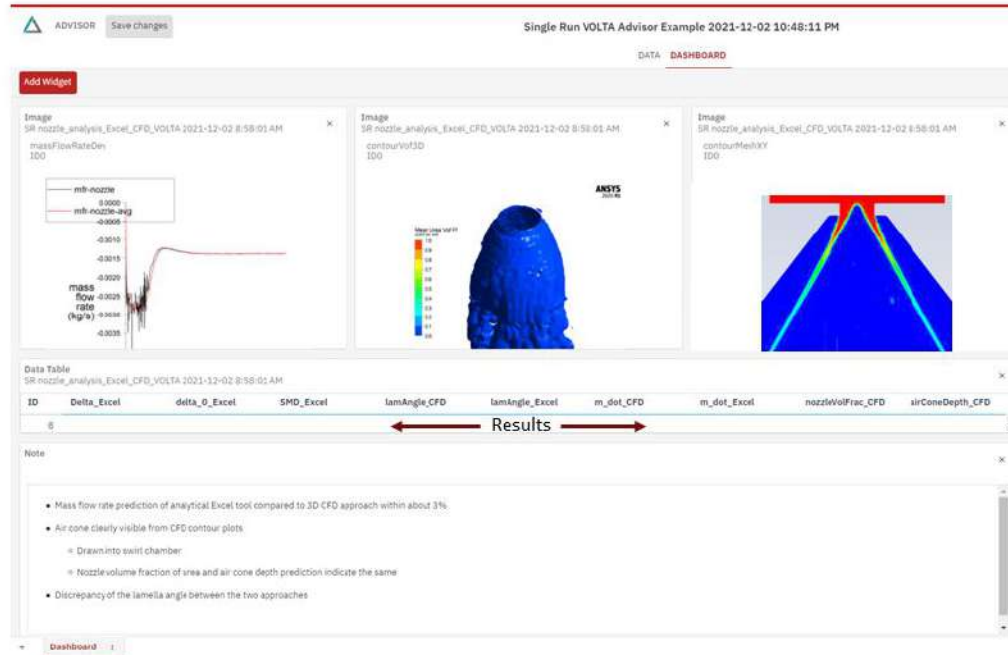
# VOLTA – ESTECO's SPDM Platform

- Manage all related models and supporting files
  - Nozzle development team specific repository
  - Analytical model, CAD geometries, 3D CFD models, ...

The screenshot displays the VOLTA SPDM Platform interface. On the left, a vertical sidebar contains navigation icons for Home, Search, Data, Myself, Teams, Simulation, and Process Manager. The main content area is divided into two panels. The left panel, titled 'Teams', shows a list of teams under 'STARRED' and 'UNSTARRED' sections. A red box highlights the 'CMHF Nozzle Development' team, which was created on Mar 29, 2021, and has an 'Unstar' button. The right panel, titled 'Teams / CMHF Nozzle Development / Simulation / 4-ArmDesign', shows a tree view of the team's structure. A red arrow points from the 'CMHF Nozzle Development' team in the left panel to the '4-ArmDesign' folder in the right panel. The right panel also features a 'New' button and a table of files. The table has columns for 'NAME' and 'CREATED'. The file 'nozzle\_analysis\_4arms\_VOLTA' is highlighted in red.

NAME	CREATED
Archive	Aug 4, 2021
DOEs	Dec 5, 2021
Project Files	Mar 25, 2021
Results (VOLTA Advisor)	Dec 5, 2021
nozzle_analysis_4arms_VOLTA	Aug 4, 2021

# VOLTA Advisor Example – Post-Processing



## Summary

- Transition from testing-intensive to simulation-based swirl atomizer development
- Integration and automation of new swirl atomizer simulation processes
- Democratization of methods with SPDM and Runbox
- Reducing prototype costs and development times while improving predictability of development
- Still a work in progress



“  
We’re making another big step in Raytheon Missiles & Defense’s digital transformation journey by selecting ESTECO’s digital engineering framework, called VOLTA, for our data sharing across the product life cycle.

This is good news for our customers, as it will help us reduce costs, increase capabilities, and shorten delivery timelines.

WES KREMER | President |  
Raytheon Missiles & Defense



“With VOLTA, ESTECO offers an interactive and user-friendly web platform that is able to cumulate smart algorithms, automation process, post processing and interactive data visualization.

The democratization of these complex methods through a friendly and ergonomic interface, offered by VOLTA, is usually and underestimated aspect of the successful deployment of solutions of this caliber.

FABIEN FIGUERES | Data Project Manager |  
Stellantis



Thanks to the VOLTA HPC & Cloud capabilities, we were able to evaluate more than 700 designs in just four days. It allowed us to execute these computational heavy multi-objective optimization analysis on the cloud without having to think how resources are used remotely.

With VOLTA, our designers and engineers can now access the simulation results in one click and collaboratively take decisions without only relying on siloed reports of data.

TORU INABA | Computational Design Group |  
Takenaka Corporation







# Thank you

[esteco.com](https://www.esteco.com)

