EXPLORE DESIGN PERFECTION

Agile Engineering Processes: the Business Impact of Simulation Democratization

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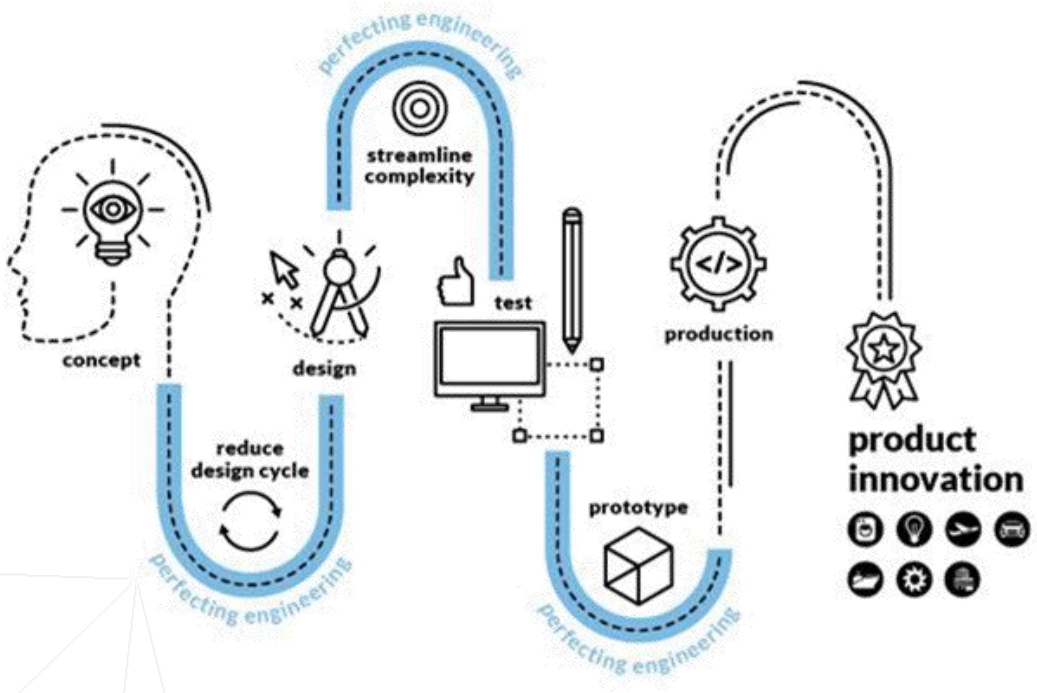
esteco.com

Agenda

- ESTECO and Ergolines
- Continuous Casting Process
- The Challenge: Back End and Front End
- Simulation and Process Automation
- Simulation Democratization: the RunBox
- Conclusions

About ESTECO

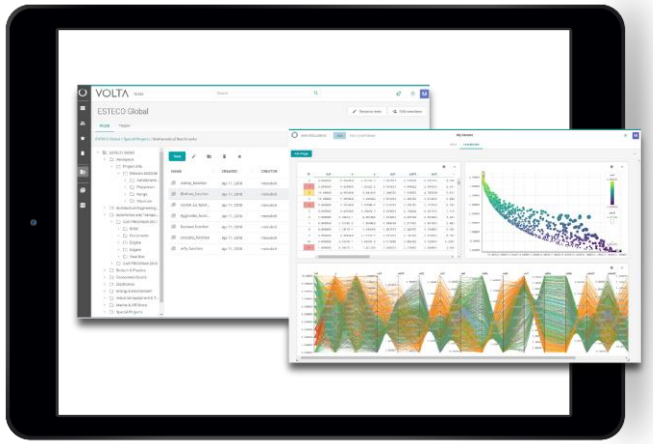
ESTECO is an independent software provider, highly specialized in numerical optimization and simulation data management with a sound scientific foundation and a flexible approach to customer needs.



With almost 20 years' experience, we support leading organizations in designing the products of the future, today.

Solutions

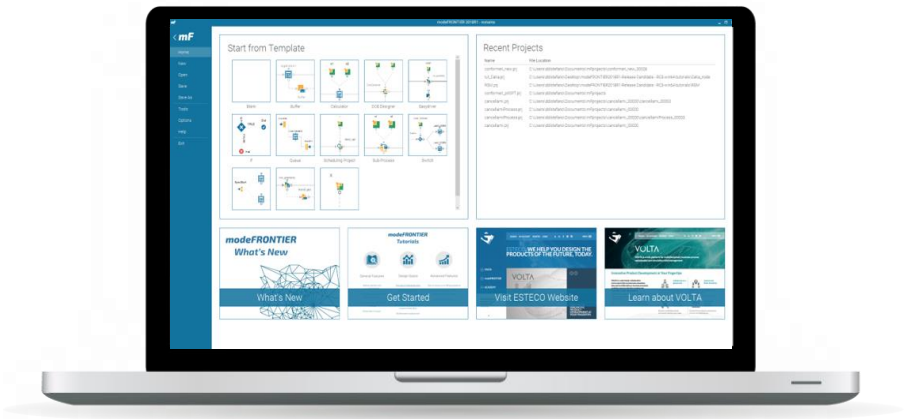
VOLTA



Enterprise environment

Multidisciplinary business process optimization and simulation data management

modeFRONTIER



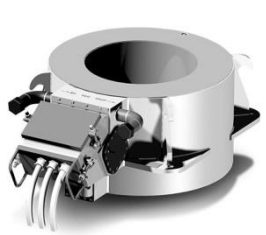
Desktop Solution

The platform for process automation and optimization in the engineering design process

About Ergolines

Ergolines is a leading company for the development, manufacturing and supply of electromagnetic stirrers and sensors for the steel industry.

Thanks to a customer oriented approach and tailor made solutions, Ergolines market extends to over 40 country in the world.

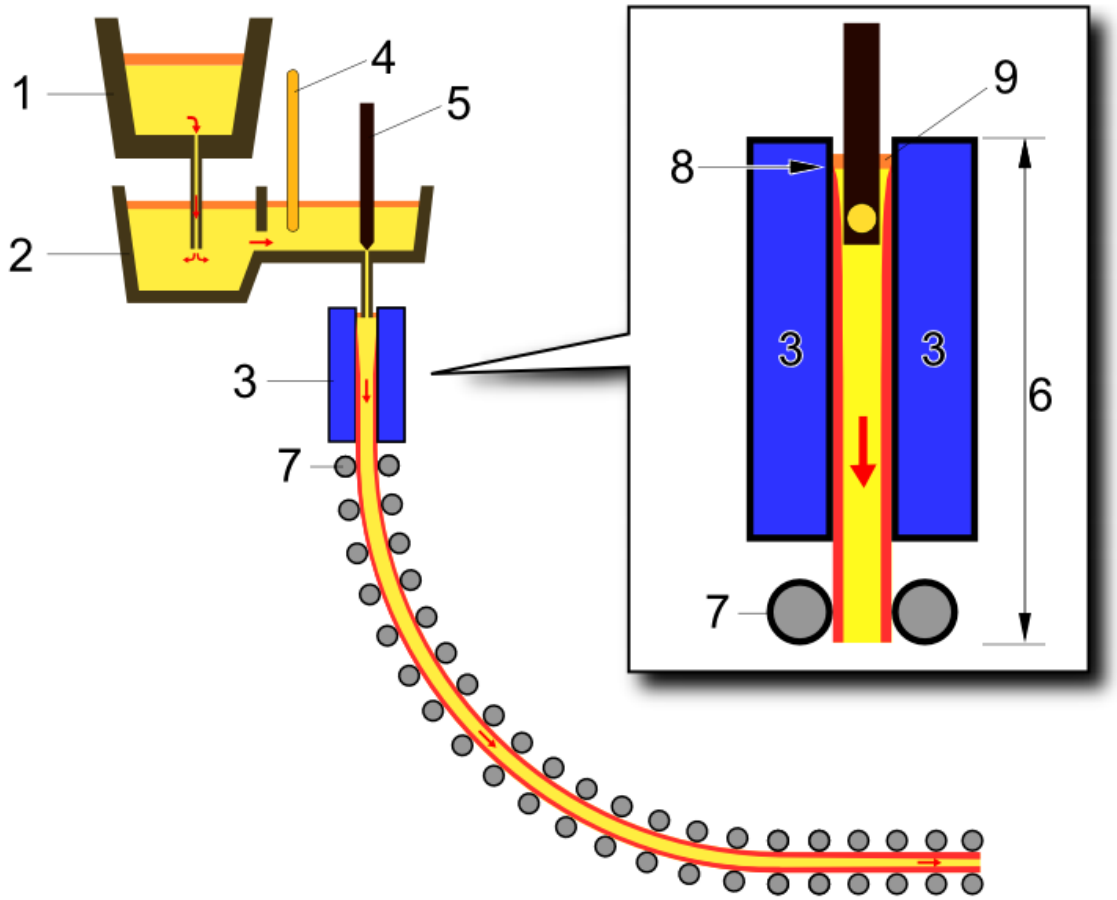


Continuous Casting Process

Steel continuous casting process presents high productivity rate.

Molten steel is solidified for subsequent rolling in machine mills.

http://www.gt-engineering.it

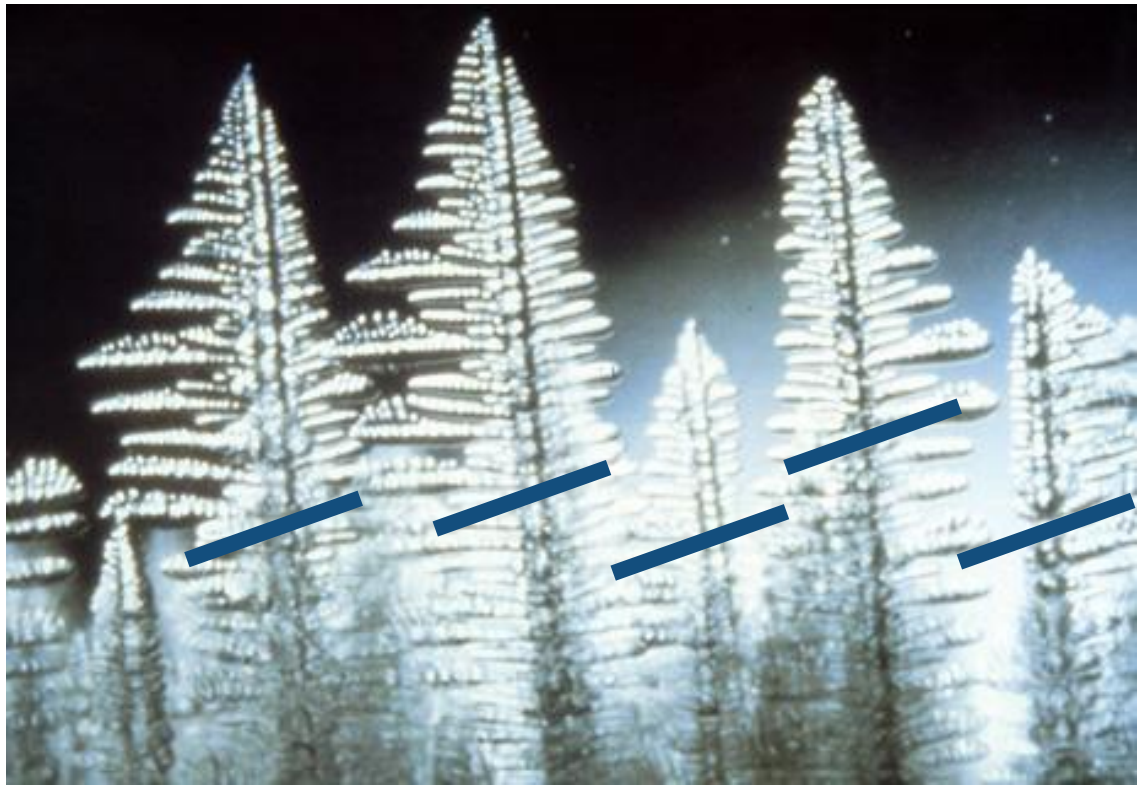


Wikipedia, Continuous Casting

The Problem

Solidification of alloy produces dendrites which decrease steel performances.

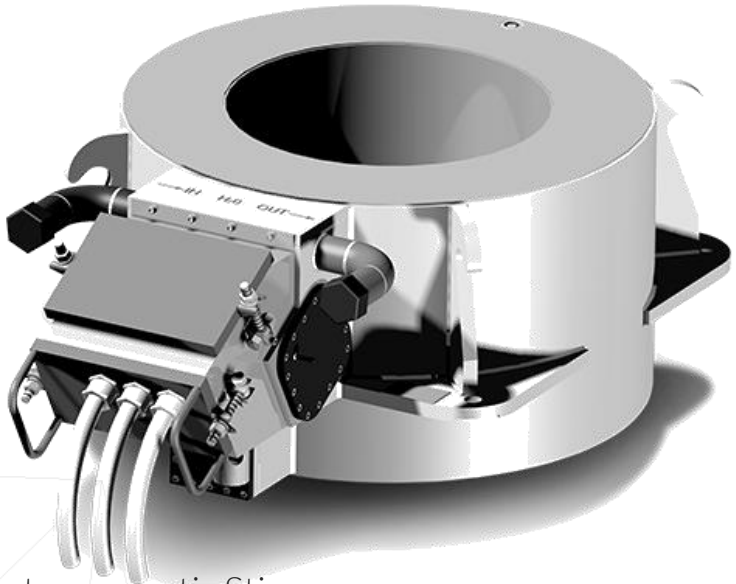
Electromagnetic stirrers avoid dendrites growth by breaking them in early solidification phases.



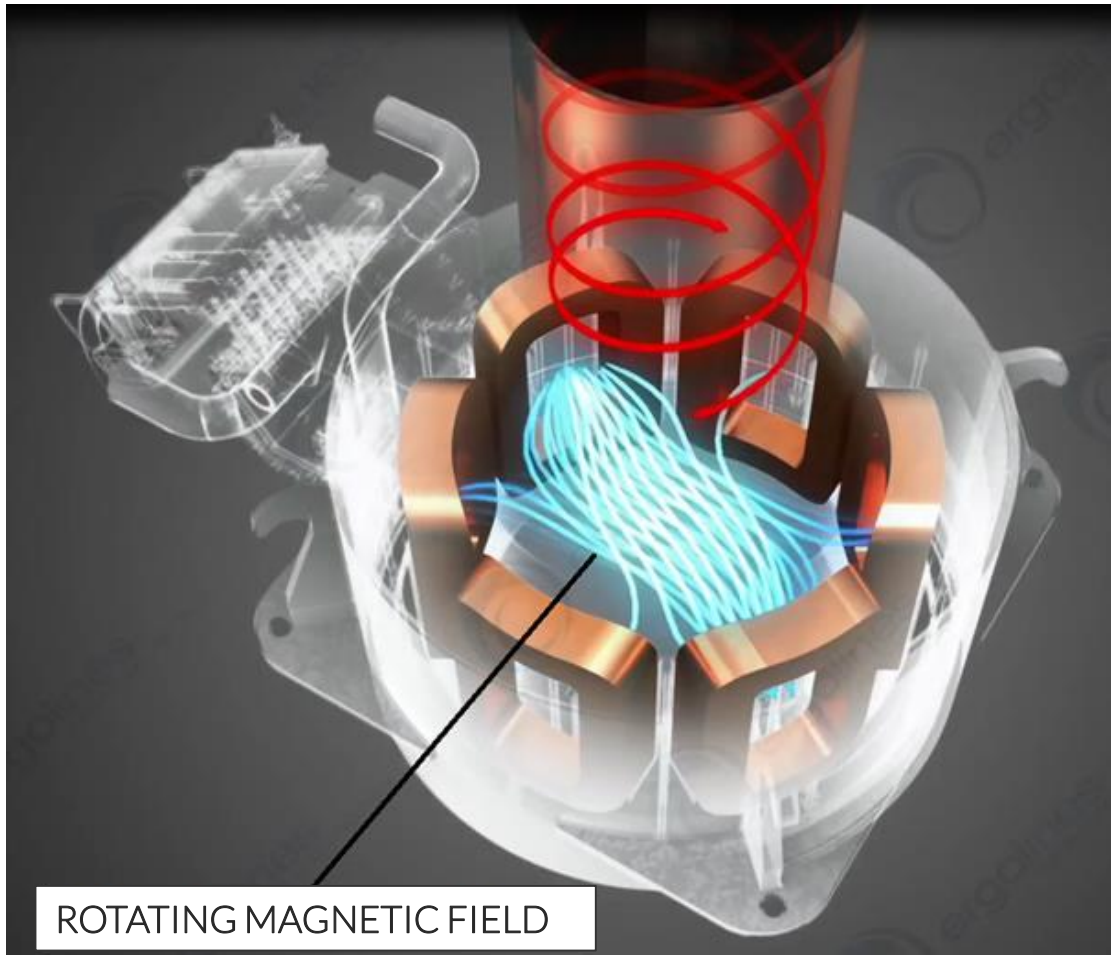
Ice dendrites

The Problem

The Electromagnetic Stirrer creates an induced velocity in the liquid steel.



Electromagnetic Stirrer

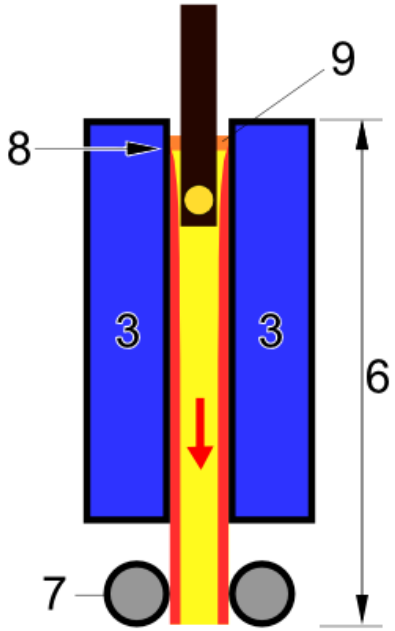


Stirrer Rotating Magnetic Field

The Challenge

Foundry engineer is in charge of stirrer **selection** and **operation** to ensure steel quality.

Optimal stirrer working point depends on **shroud** type.



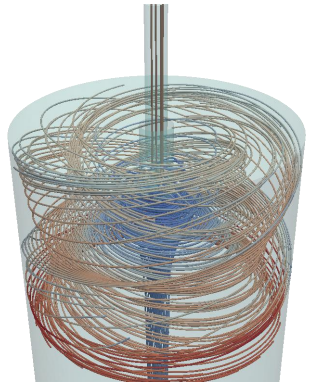
Wikipedia, Continuous Casting

Foundry Engineer Problem

Foundry Engineer

Time and **Resource** consuming process

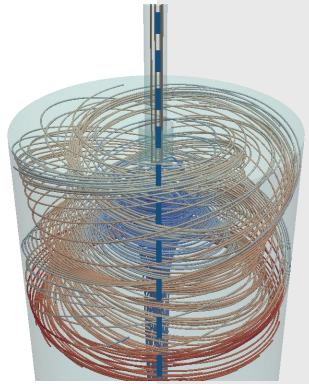
Ergolines



Simulation

Foundry Engineer Problem

Foundry Engineer



Simulation

Ergolines

Front End

Back End

The Problem

1. Allow foundry engineers to direct access optimal stirrer performances in specific conditions
2. Take advantage of simulation without having to deal with its complexity

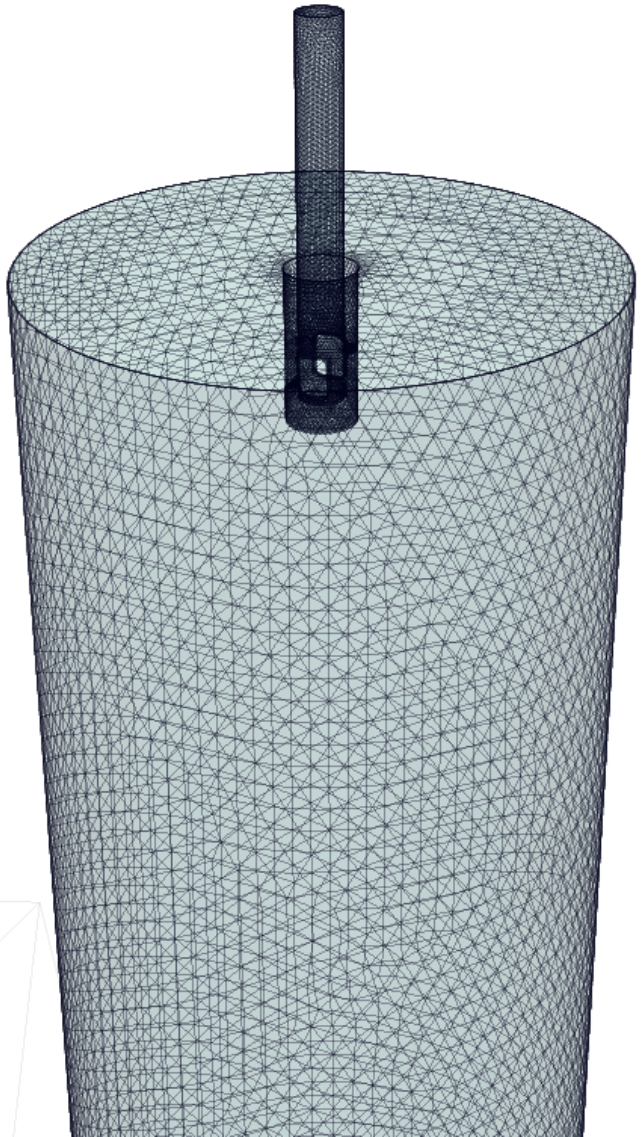
iCAST

innovative Computer Aided Solidification Technology

iCAST Project

1. **Automation** of simulation process
2. **Configuration** of the automated process
3. **RunBox** creation for the foundry engineer

iCAST Process



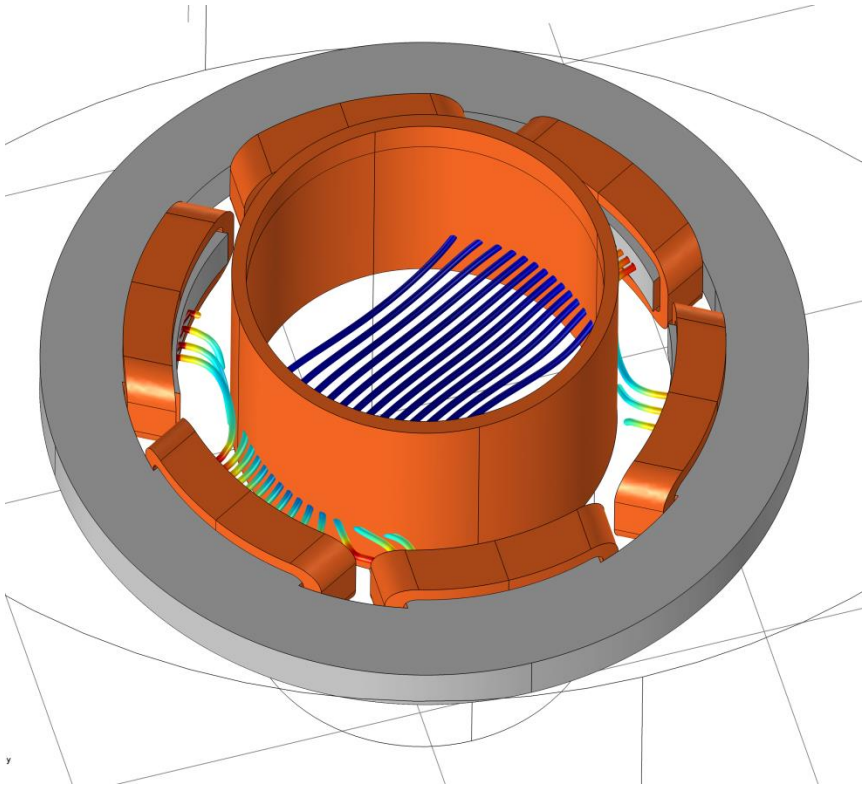
Geometry and mesh with SALOME* requires Python scripts for:

1. Geometry definition

2. Mesh definition

*http://www.salome-platform.org/

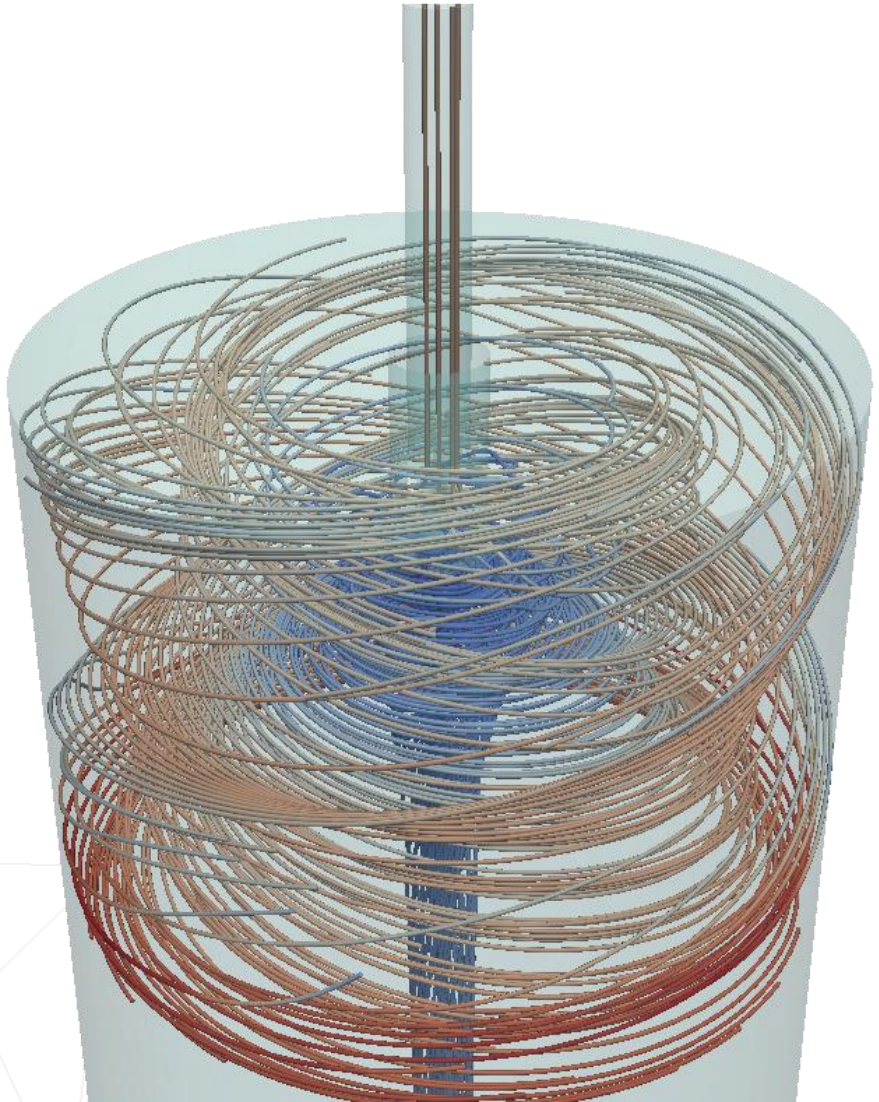
iCAST Process



Electromagnetic solution requires 20 hours of simulation.

Electromagnetic field is injected into fluid dynamic field for the complete solution.

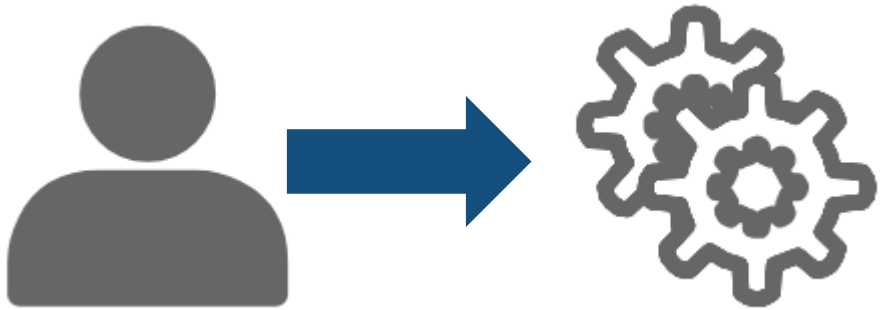
iCAST Process



CFD solves the flow field in mold under the action of the electromagnetic field.

Process Automation

Automation is the key: machines can execute an automatic process.



Simulation Expert

Simulation Expert creates and versions:

Geometry Model

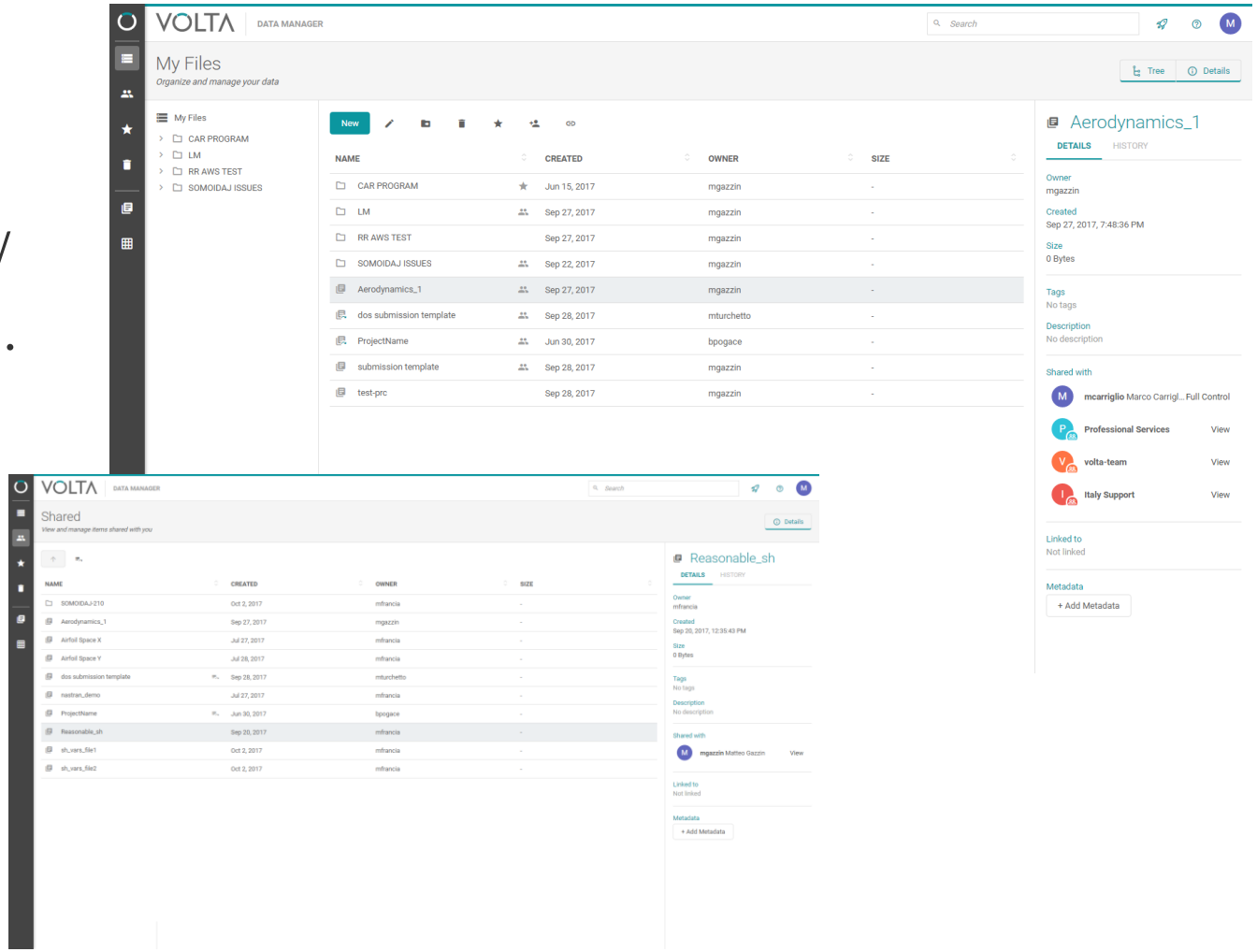
Electromagnetic Model

Fluidynamics Model

Process Automation Expert **needs to integrate** latest model version in the process

Simulation Data Management

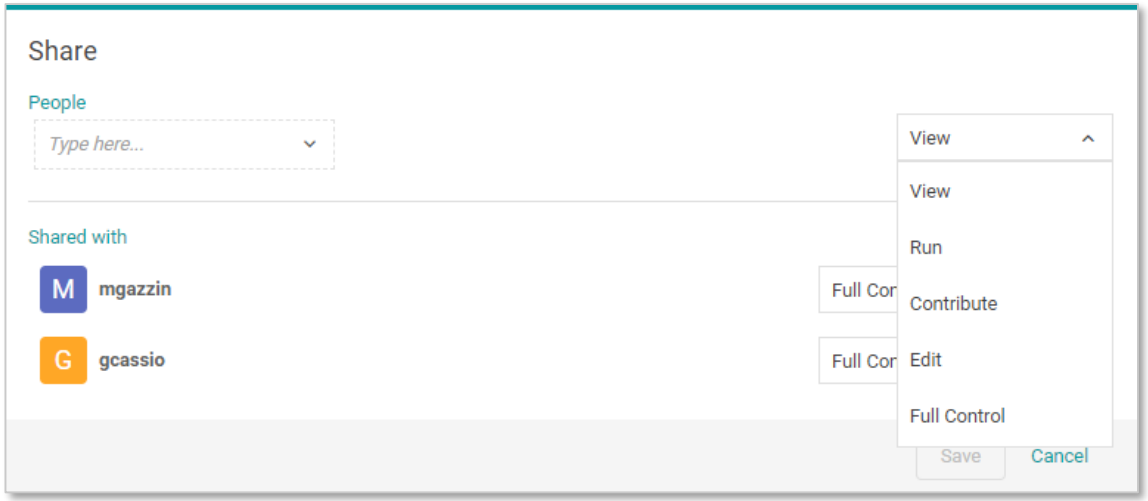
Ergolines uses VOLTA data management capabilities to allow model versioning and integration.



Model Sharing between Domain Experts and Automation Experts

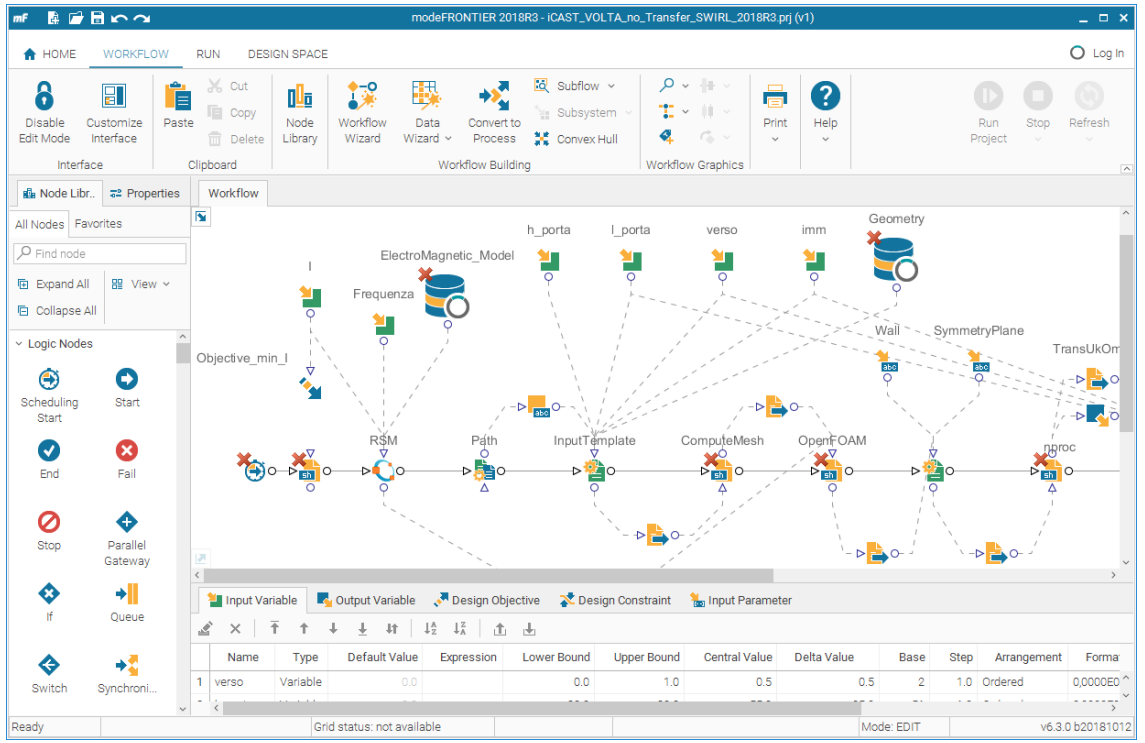
Allows Process Automation Expert to integrate the model without sharing the complete model: permissions

Allows Ergolines to preserve Intellectual Property.

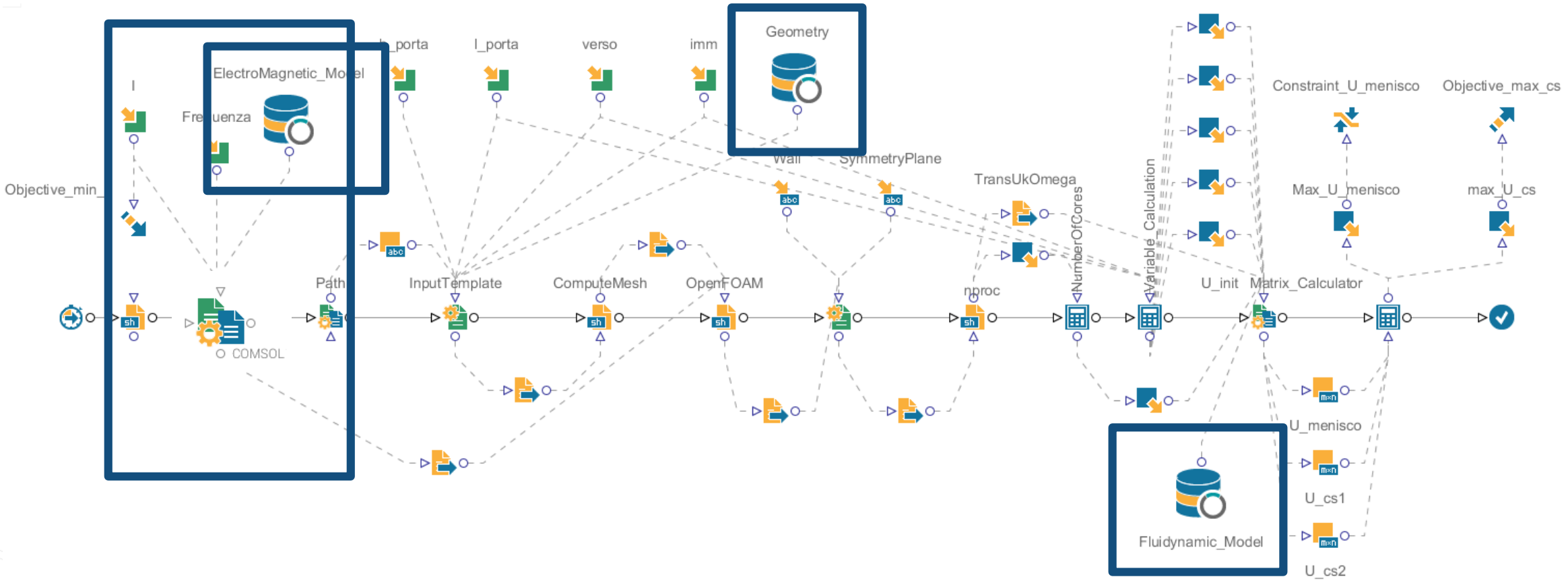


Process Automation with modeFRONTIER

modeFRONTIER allows to design the automation process using its **integration** and **workflow design** capabilities.

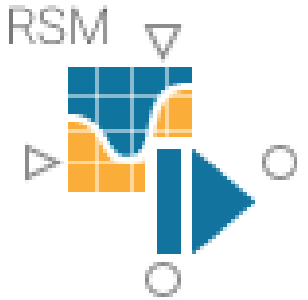


Process Automation



Electromagnetic Model

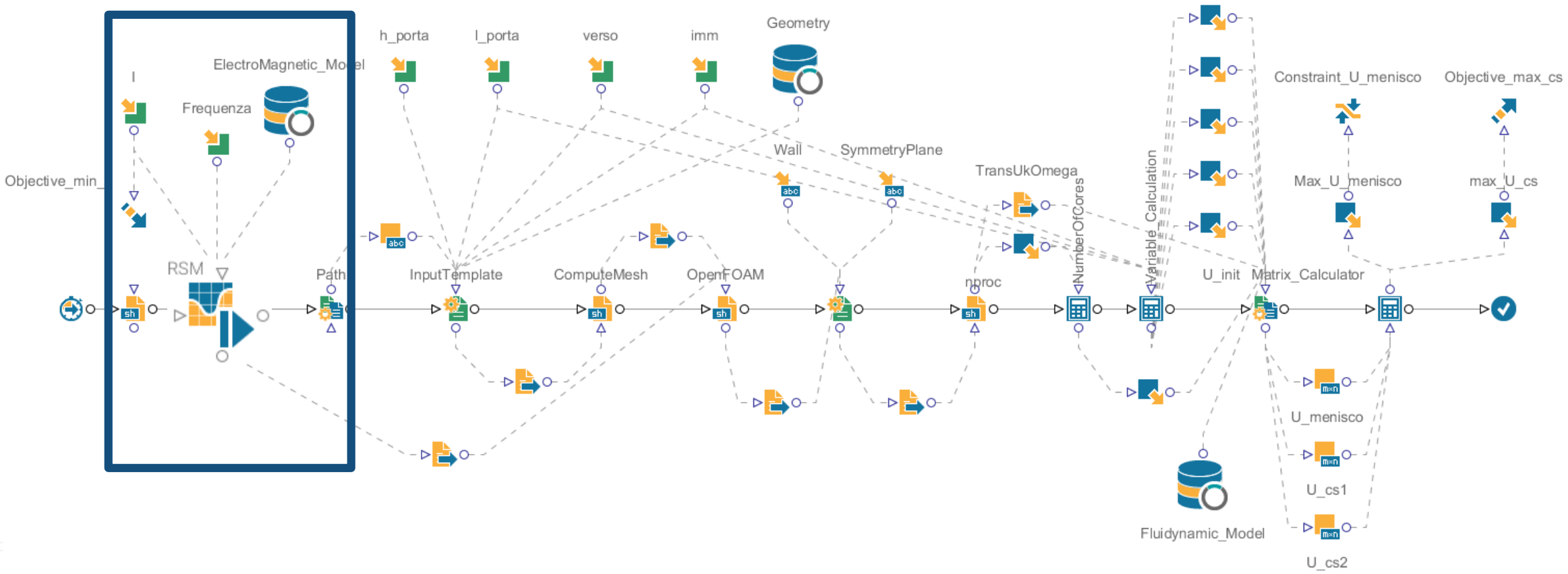
20 Hours



2 Minutes

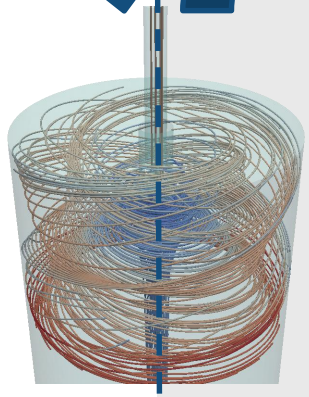
Excellent prediction: error<0,5%

Process Automation



Foundry Engineer Problem

Foundry Engineer



Simulation

Ergolines

Front End

Back End

RunBox Application

Workflow is published in VOLTA and RunBox Application can be created for the Foundry Engineer

It is a complexity-hiding layer to empower Foundry Engineer with simulation prediction.

Two Actors:

1. RunBox Application Owner: who configures and publish the RunBox
2. Foundry Engineer: RunBox end-user

RunBox Creation

Ergolines Application Owner configures relevant variables for the Foundry Engineer.

Inputs

Import Inputs

Scalar Inputs

Name	Constant	Exposed	Value	Lower Bound	Upper Bound	Step	Base	Arrangement	Full name	Unit
Frequenza	☐	☑	0.0	0.5 (0.5)	2.0 (2.0)	0.0	0	Ordered	Stirrer Working	Hz
I	☐	☑	0.0	0.0 (0.0)	800.0 (800.0)	100	9	Ordered	Stirrer Current I	A
angolo	☑	☑	0.0	-15.0 (-15.0)	15.0 (15.0)	1	31	Ordered	Shroud Angle	°
h_porta	☑	☑	0.0	30.0 (30.0)	80.0 (80.0)	1	51	Ordered	Shroud Port He	mm
imm	☑	☑	0.0	80.0 (80.0)	150.0 (150.0)	1	71	Ordered	Shroud Depth	mm
l_porta	☑	☑	0.0	30.0 (30.0)	60.0 (60.0)	1	31	Ordered	Shroud Port Wi	mm

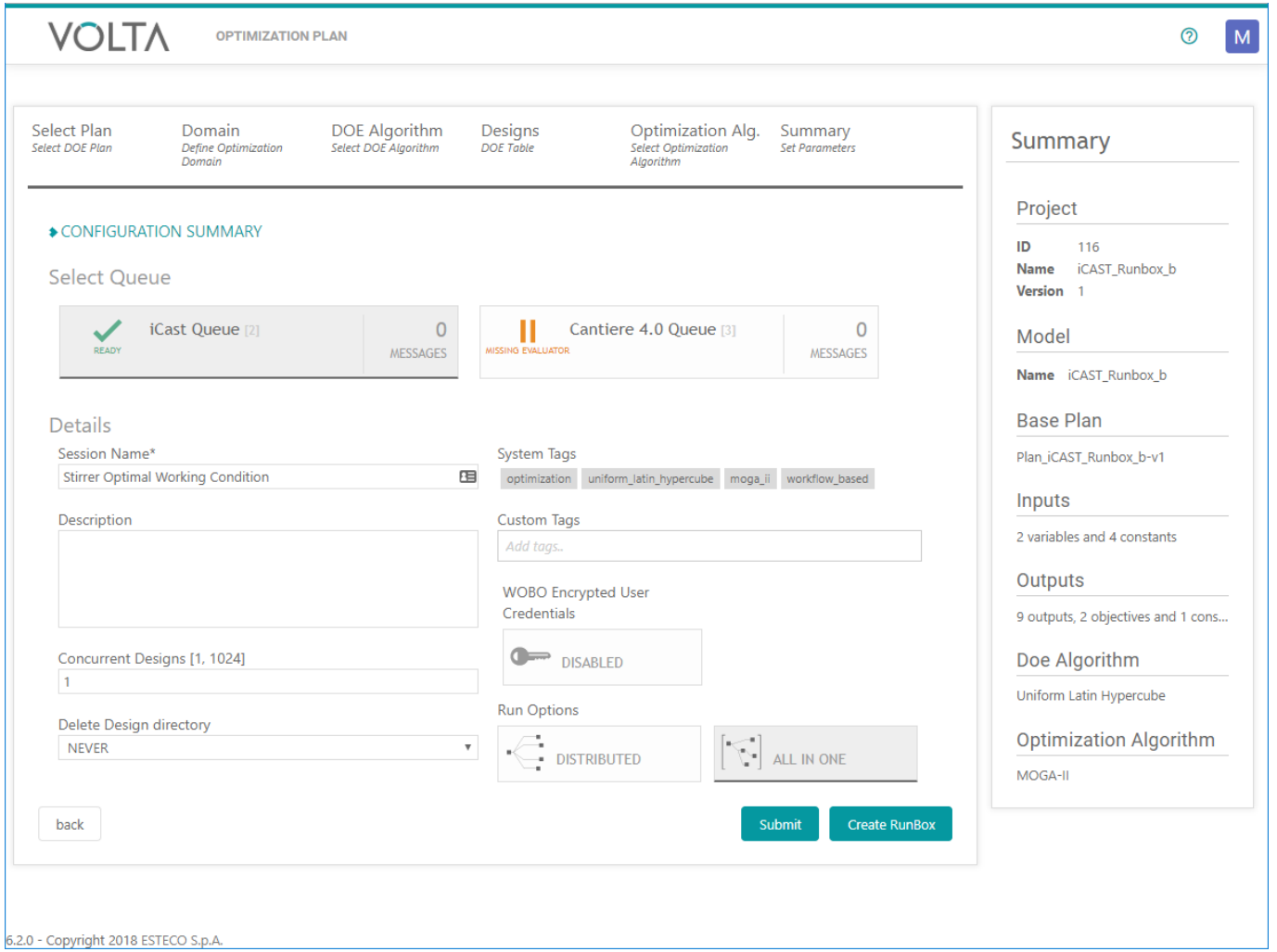
Outputs

Scalar Outputs

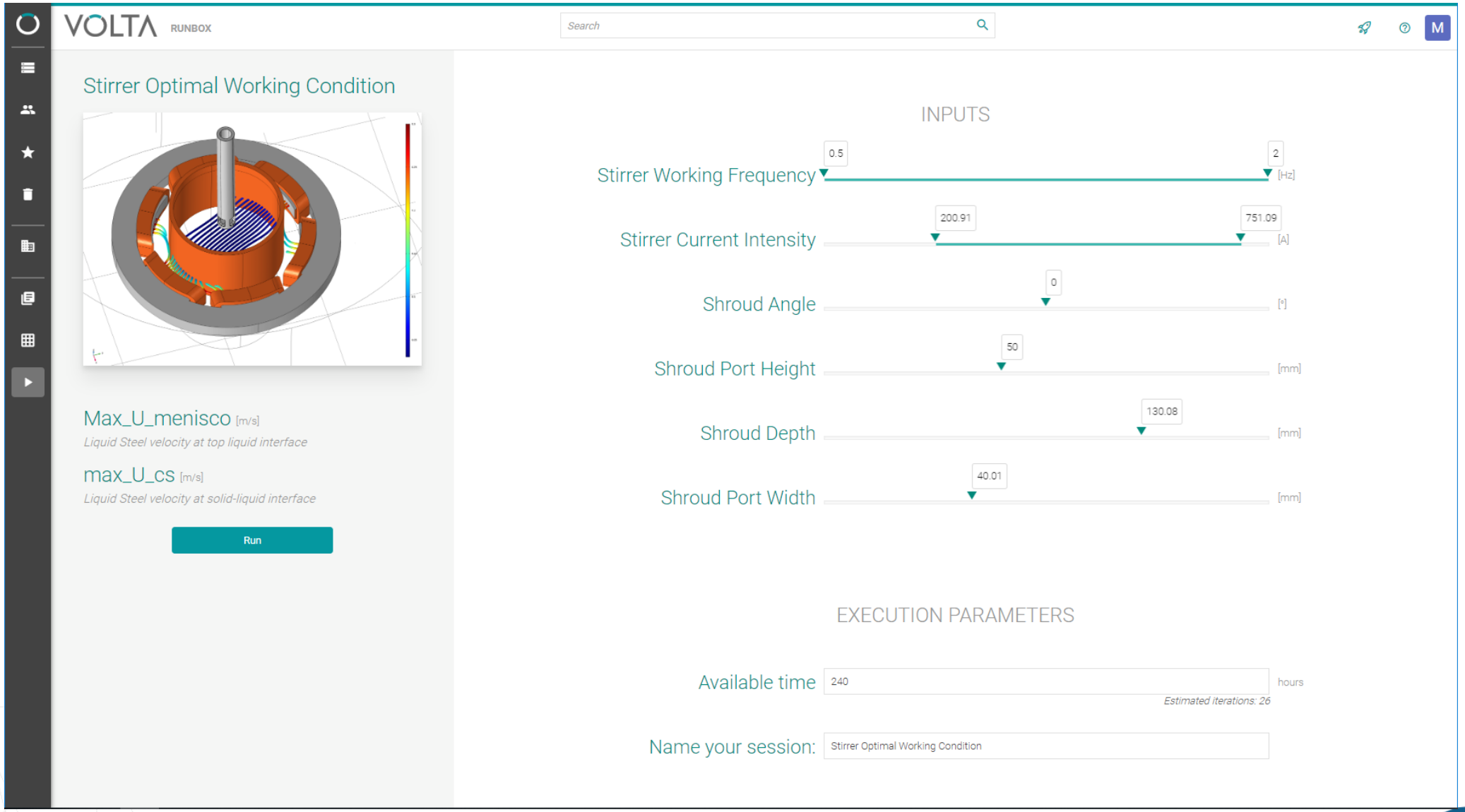
Name	Exposed	Long name	Description	Unit
K	☐			
Kdecimi	☐			
Max_U_menisco	☑	Free Surface Velocity	Liquid Steel velocity at top liquid interface	m/s
Omega	☐			
OmegaDecimi	☐			
U	☐			
max_U_cs	☑	Tangential Velocity	Liquid Steel velocity at solid-liquid interface	m/s
ncores	☐			
nproc	☐			

RunBox Creation

1. Select computation resources
2. Assign name
3. Create RunBox Application



RunBox Application accessed by Foundry Engineer



Problem of Intellectual Property

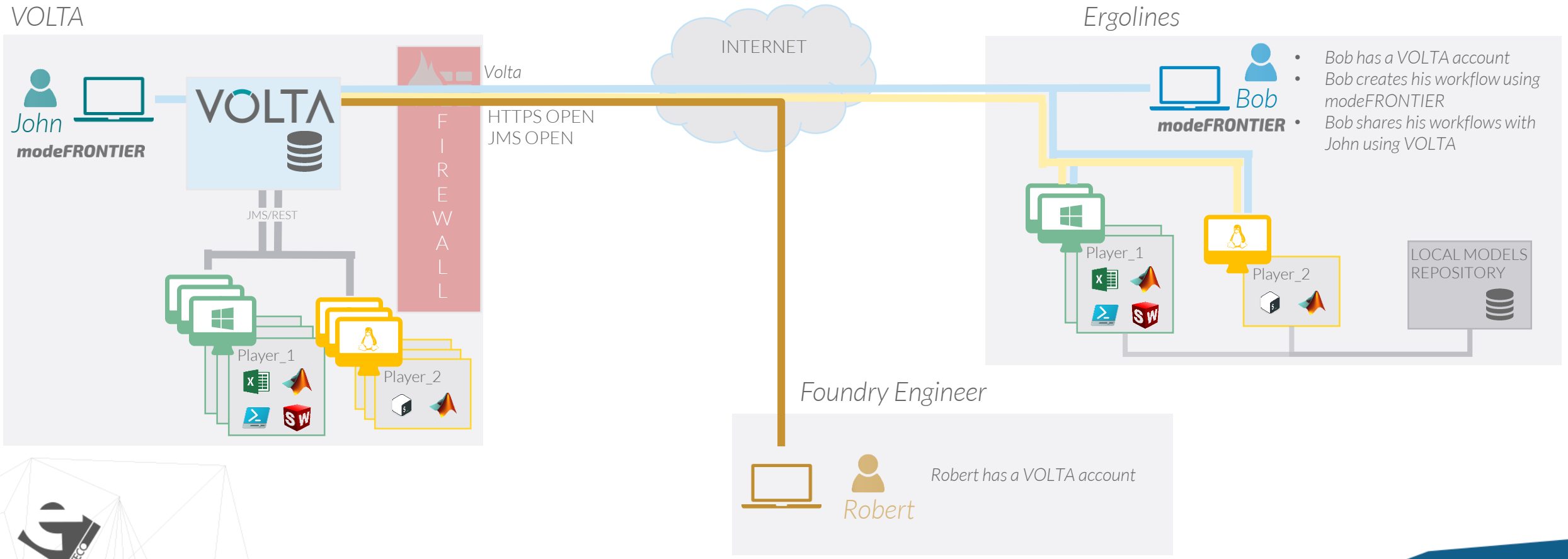
Ergolines uses proprietary models for:

- Geometry description
- Electromagnetic simulation
- Weak Coupling Model to inject electromagnetic field into Fluid dynamic field
- CFD simulation

Ergolines wants to keep intellectual property.

Execution

Models run on Ergolines Lab machines to safeguard **Intellectual Property** and **sensitive data**.



Business Impacts

Benefits for Foundry Engineers:

- Quick and reliable prediction of optimal stirrer working point
- Easy simulation of different stirrer models
- Appropriate fidelity models
- Don’t need to worry about license management

Business Impact

Benefits for Ergolines:

- Explore innovative shroud and stirrer configurations
- Best stirrer selection for customer needs
- Allow customers to perform stirrer simulations while preserving company know-how
- Prediction of stirrer performances for a given environment
- Scalable approach for multiple customers

Thanks for the attention!

EXPLORE DESIGN PERFECTION

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