

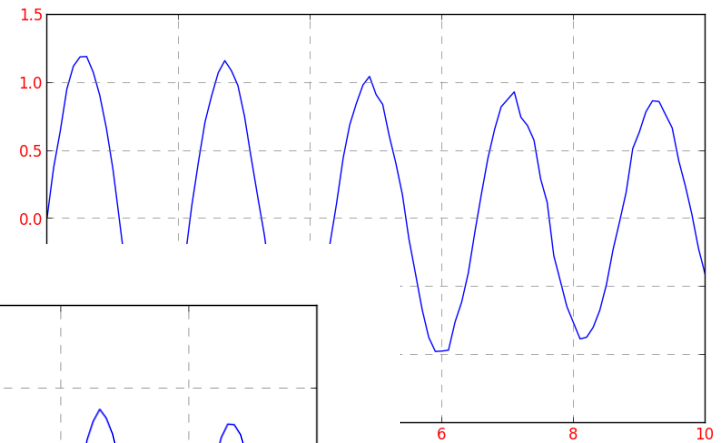
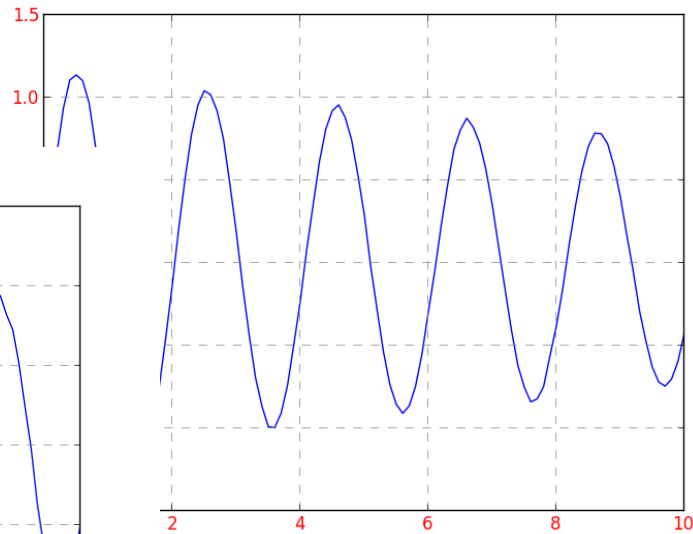
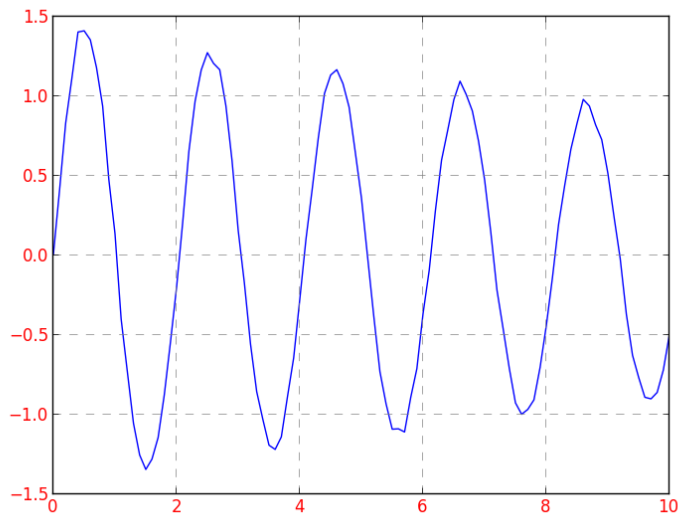
Digital Twin



“combine sensor data with detailed product simulation”

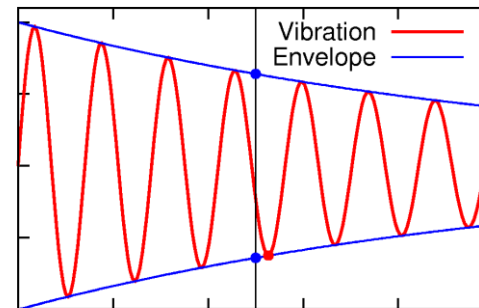
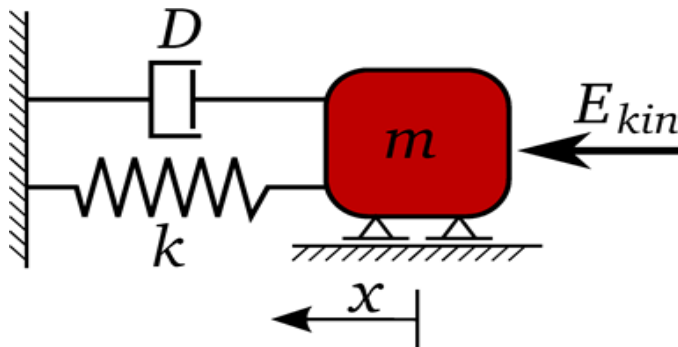
Sensor data

- Measurement of a time-dependent oscillation



Example for this presentation

- Energy
 - Mass
 - Stiffness
 - Damping
- Loading
- machine condition needs to be controlled for maintenance



- ➔ Identify the parameters based on digital twin simulation

Motivation

Customer or Customer of customer ...

→ Look into the product (simulation shows what can not be measured)

→ Manage maintenance

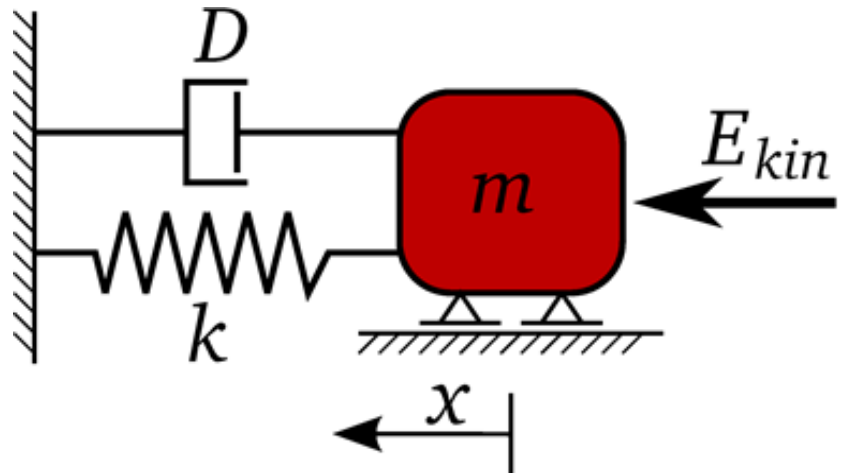
→ Find optimal operating parameters

→ ...

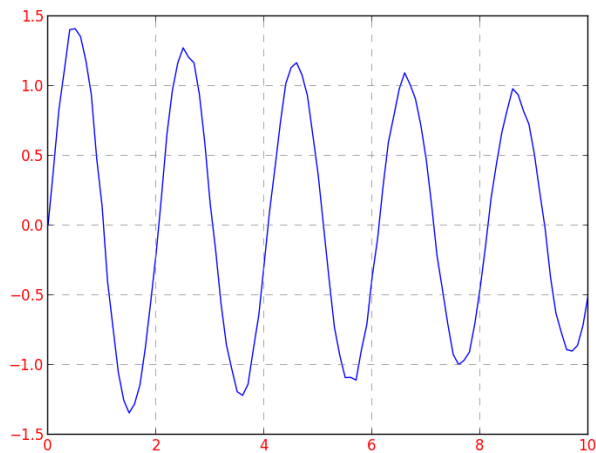
→ Traceable processes & results

→ Web-based (everywhere, everytime)

→ ...



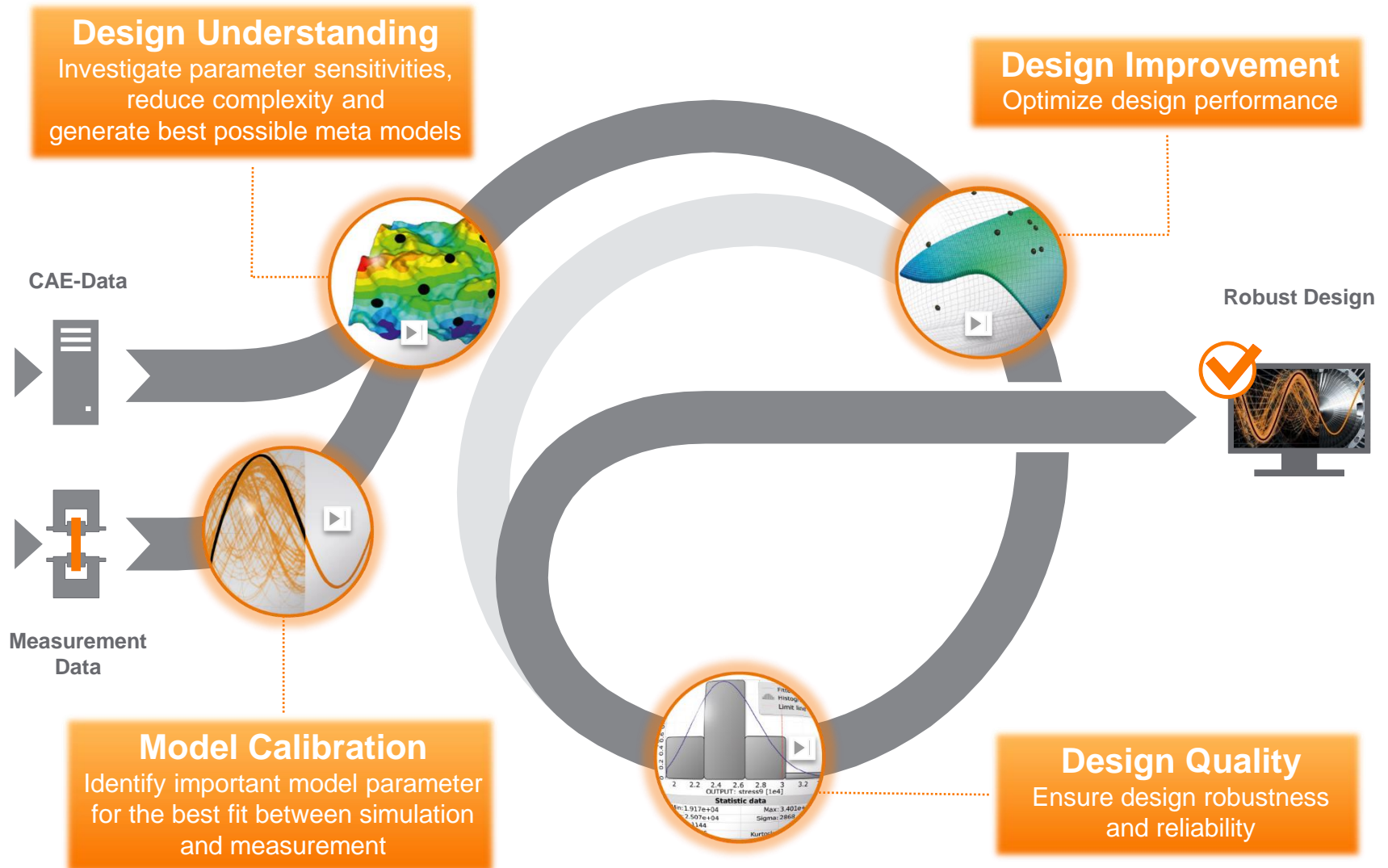
Identify the parameters



...Simulation...

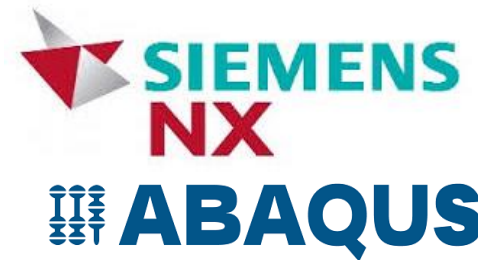
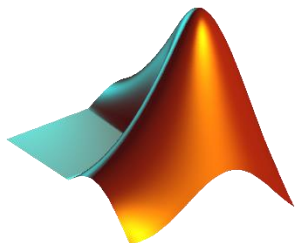


Parameter	
D	
Ekin	
k	
m	



Simulation workflow management

- Connect the tools our customers are using
 - ANSYS
 - 3rd-party
 - PLM
 - in-house
- CAx workflow building
 - Organize sequence/loops/conditions
Loops can be e.g. DOE, optimization, performance grid
- open architecture (plugins & interfaces)

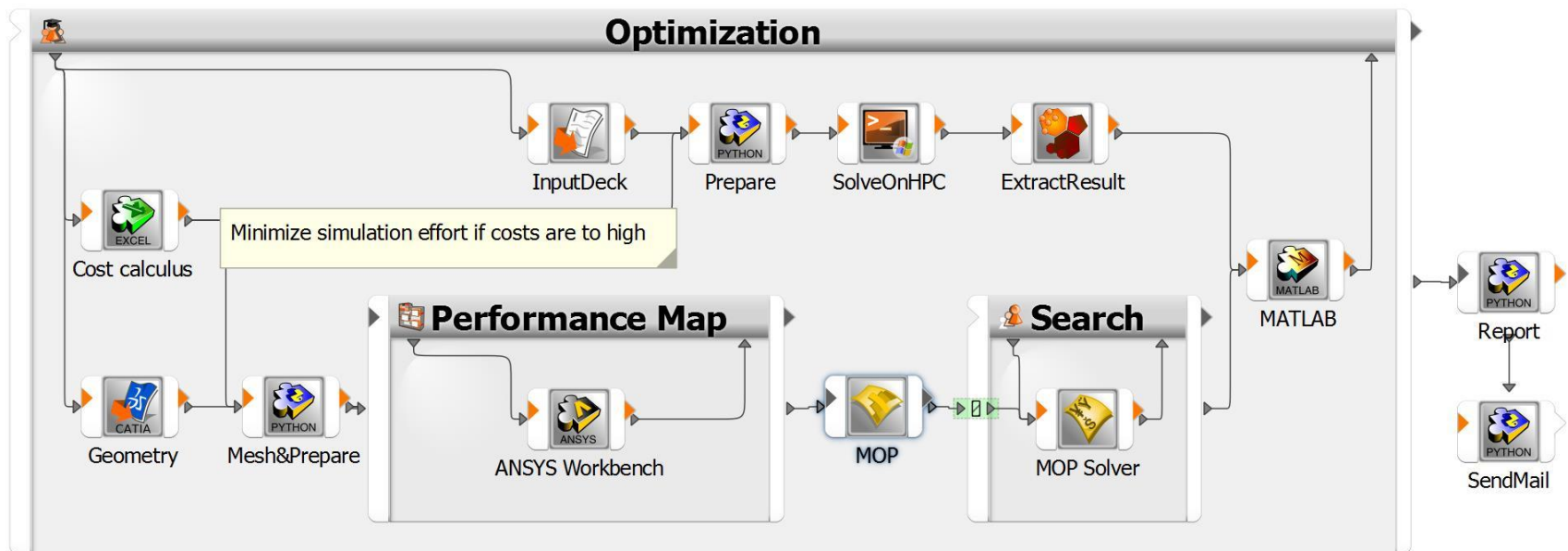


Process integration and automation

optiSLang provides

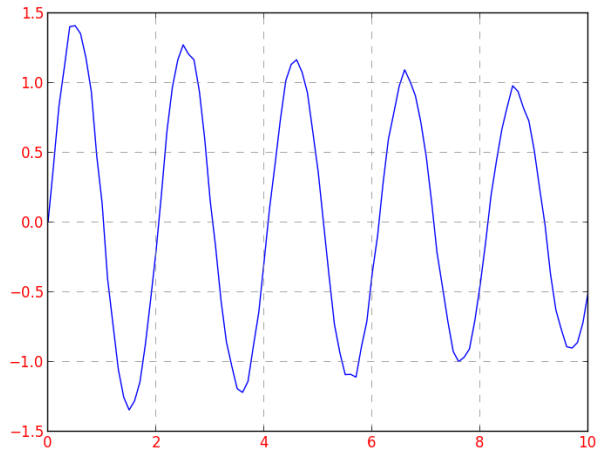
- full flexibility to build (parametric) workflows
- integrating arbitrary CAX tools





➔ run design variations automatically



Machine condition calibration flow

- Generate an identification flow in optiSLang



Parameter	
D	
Ekin	
k	
m	



SPDM – connect “data” and simulation



Product parameter

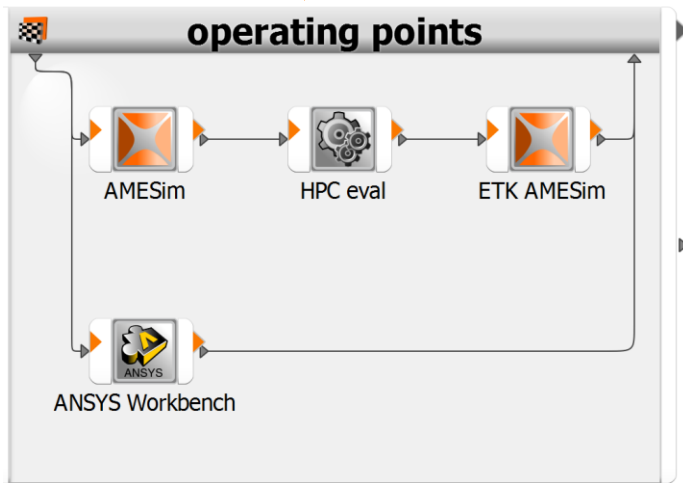
Name	Resolution	Range		Criterion	Right side expression
		Left side expression			
X1	Continuous	-3.14	3.14		
X2	Continuous	-3.14	3.14		
X3	Constraint	Y		≤	10



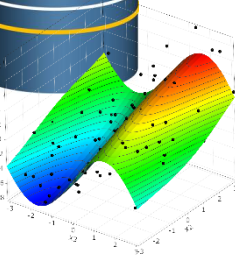
CAE Model



CAE Model

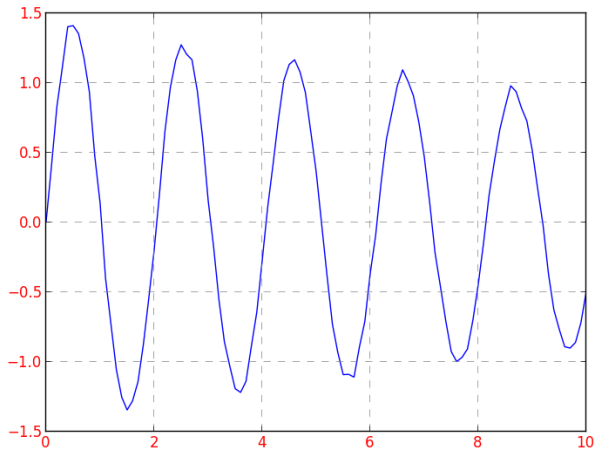


Results

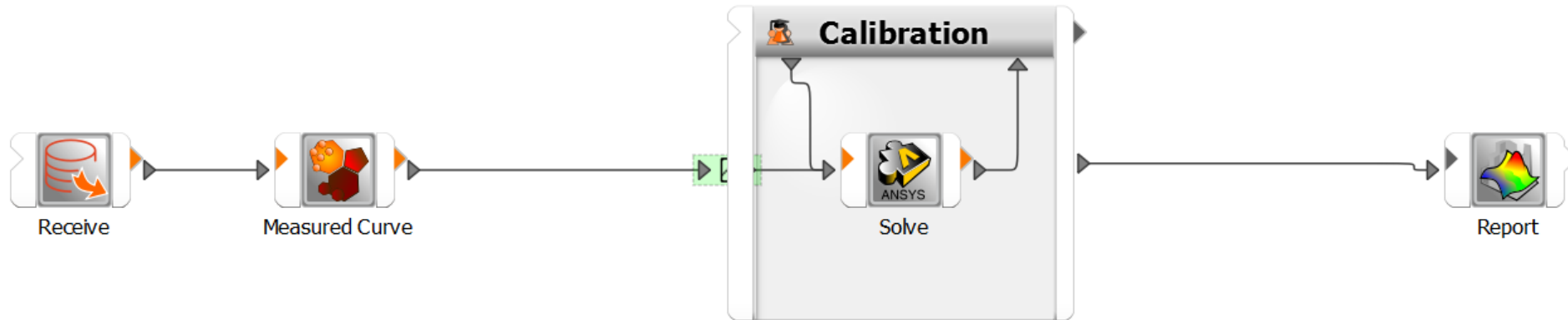


Machine condition calibration flow

- Generate an identification flow in optiSLang



Parameter	
D	
Ekin	
k	
m	



PLM/SDM system is central component
optiSLang for SPM, standardization and automation



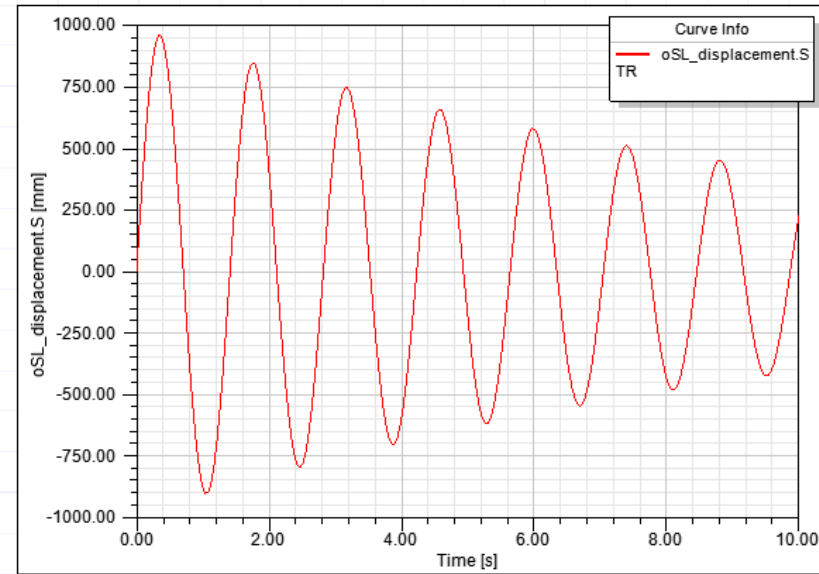
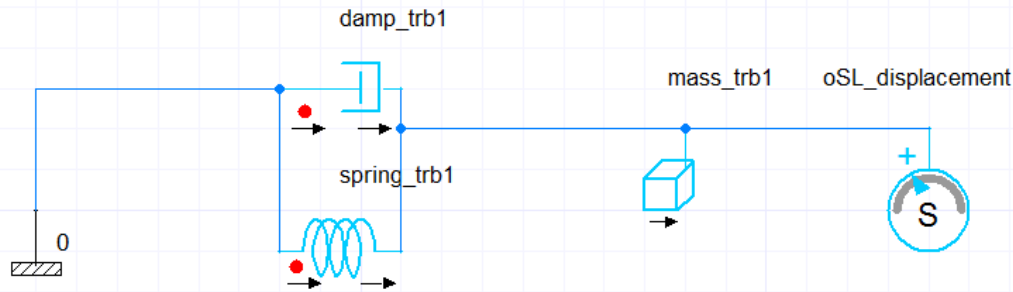
Democratization



- **CAx Expert**
 - Builds (Simulation)-model
 - Takes care about correctness
 - Defines „Parameter“ for CAx Workflow expert
 - Stores model in Database

Simulation expert

→ Builds and maintains sim-model



Revised work



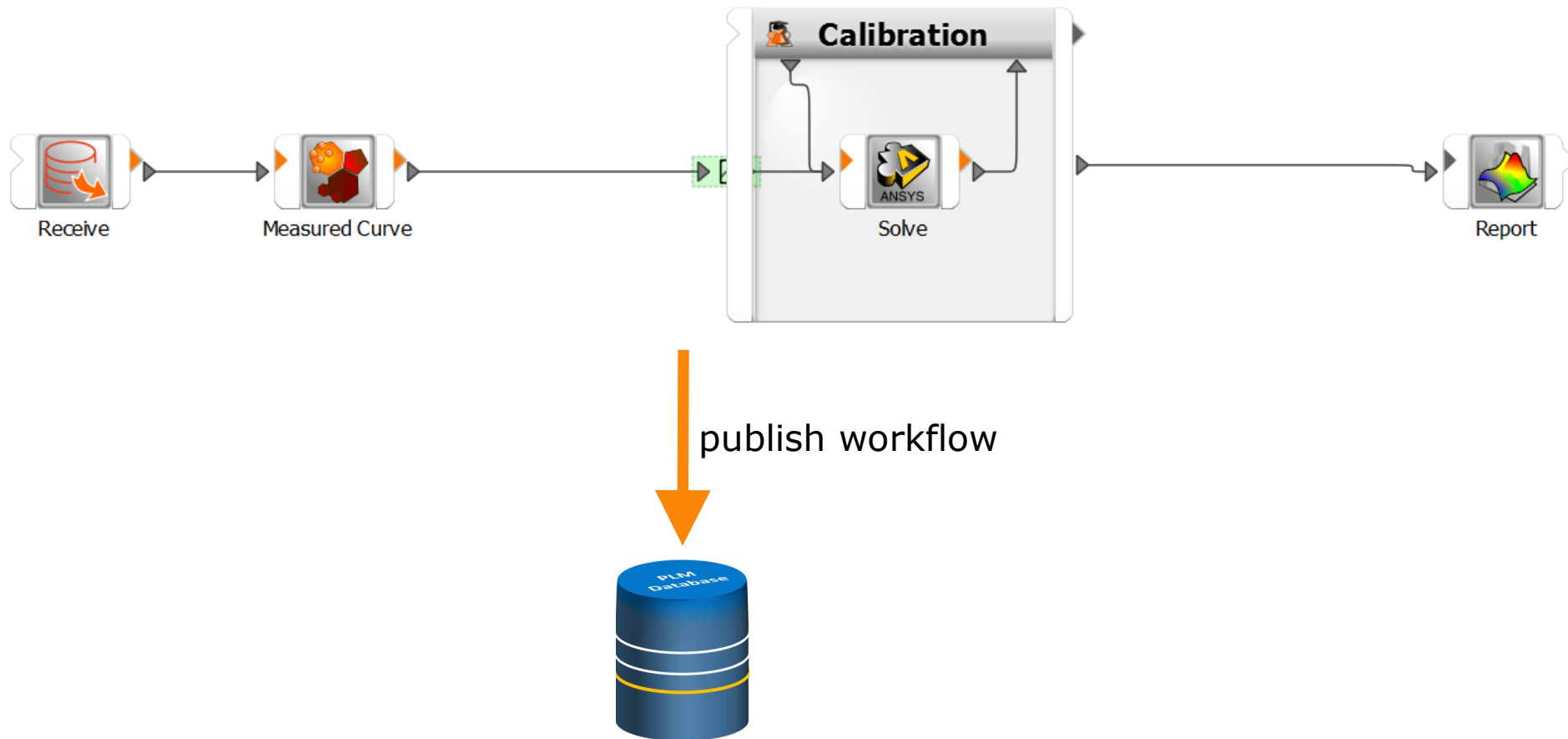
Democratization



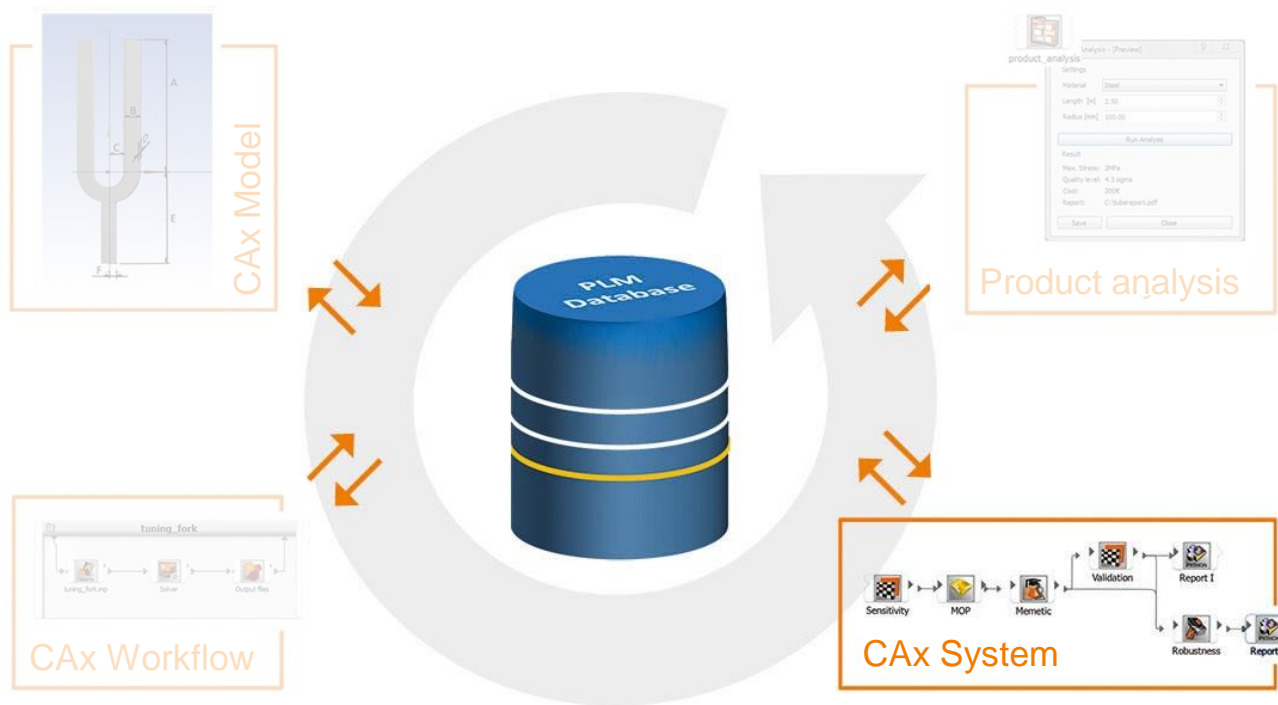
- CAX Workflow Expert
 - builds (simulation-) process
 - Defines „Parameter“ for CAX System Expert
 - Stores/revisions workflow in database

Workflow engineer

→ builds and maintains calibration workflow



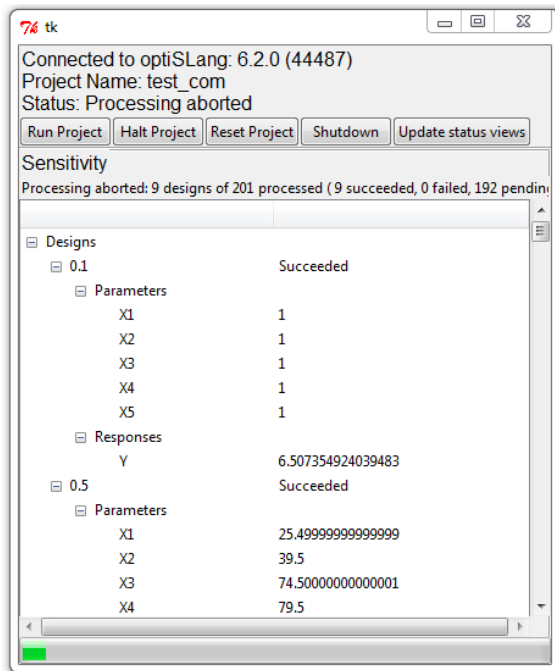
Democratization



- **CAX System Expert**
 - Combines disciplines
 - Has simultaneous view on different/all domains
 - Defines „Parameter“ for Product Analyst
 - Stores/revisions workflow in database

optiSLang Remote – Control „The Cloud“

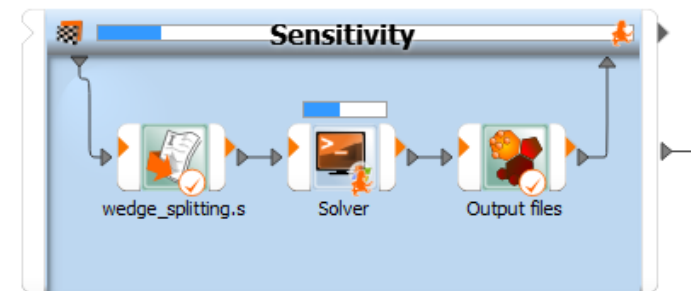
- End user can Monitor Status of optiSLang project
- End user can interact with optiSLang project



- via TCP/IP
connect to submitted project

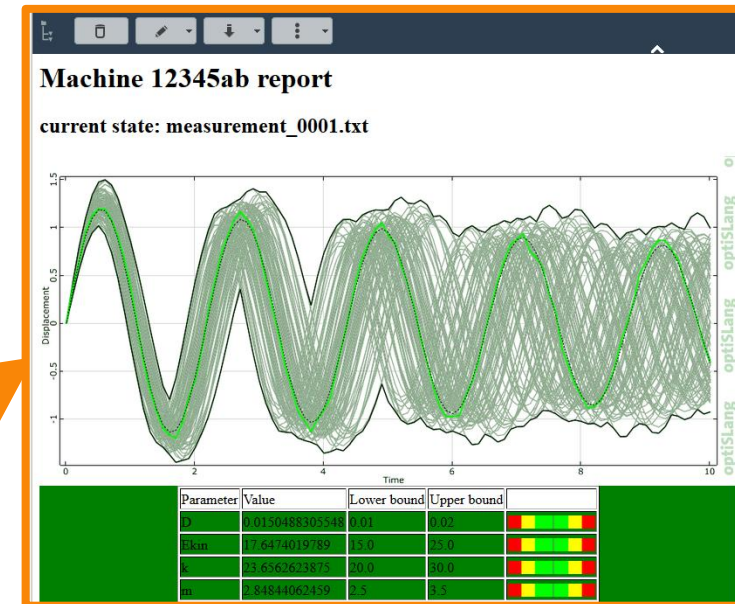
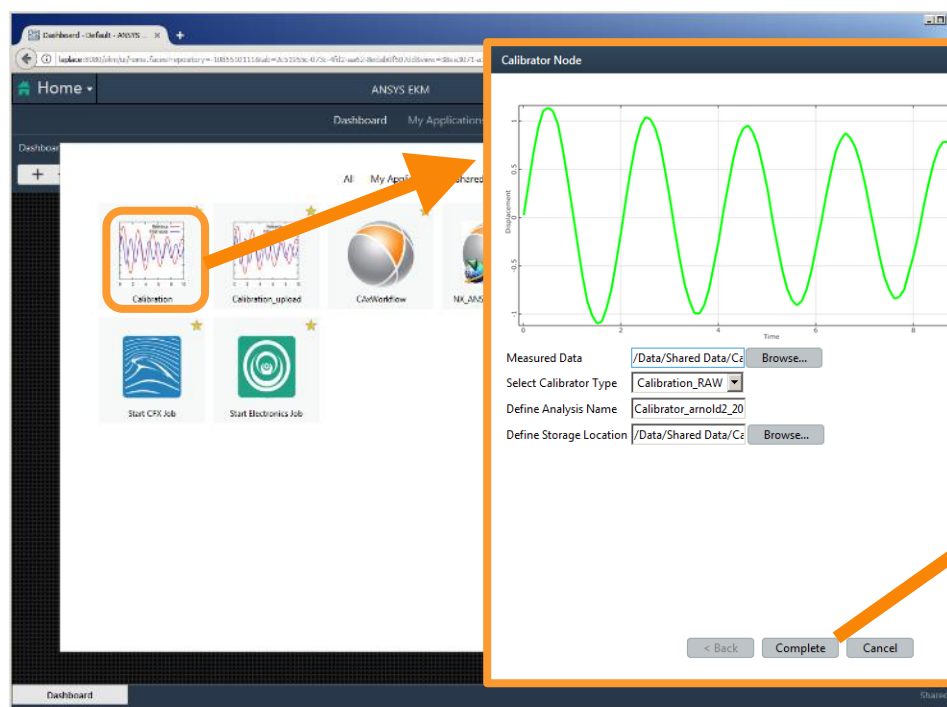
- Get Status
(Project, node...)

- Start/Stop/Reset
(Project, node, single id)



„in-field“ engineer

- Start APP in web browser and select measurement curve
- Or: Automatic trigger, when new curve is measured
- ➔ Identifies machine parameter automatically



Results

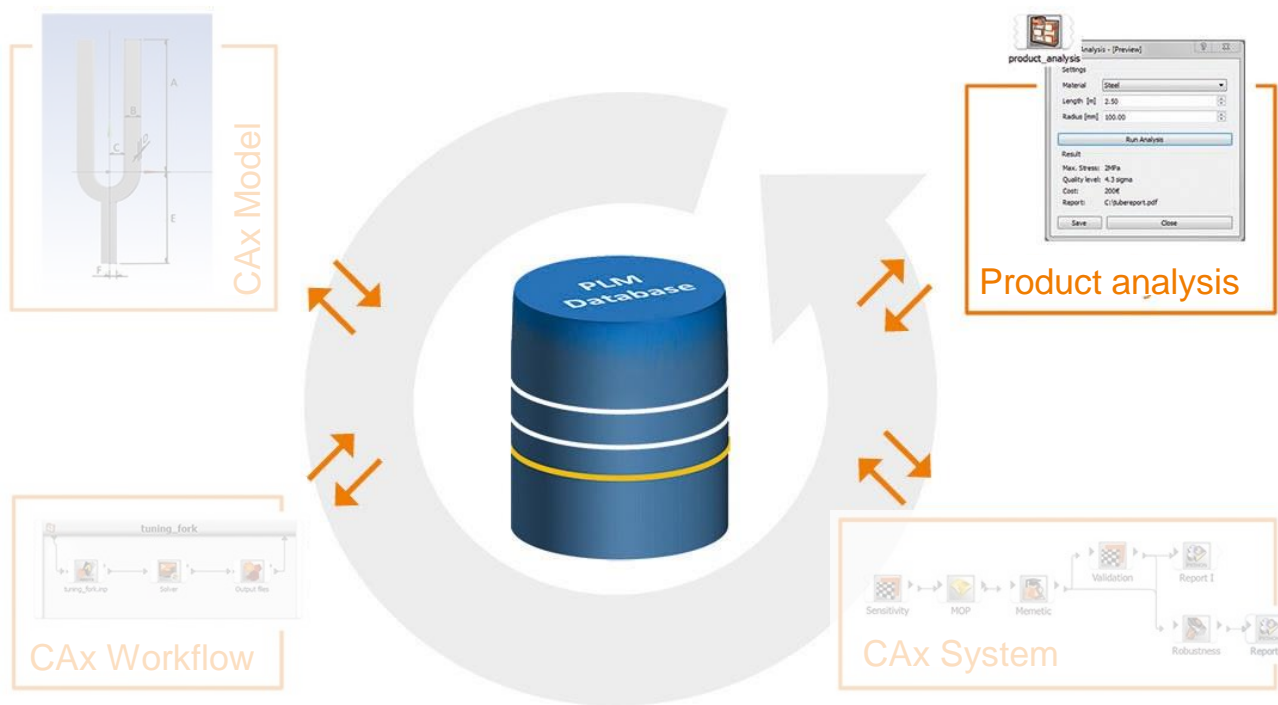
→ Identified conditions and values as html report.

→ *.csv file extraction

→ Send report as email



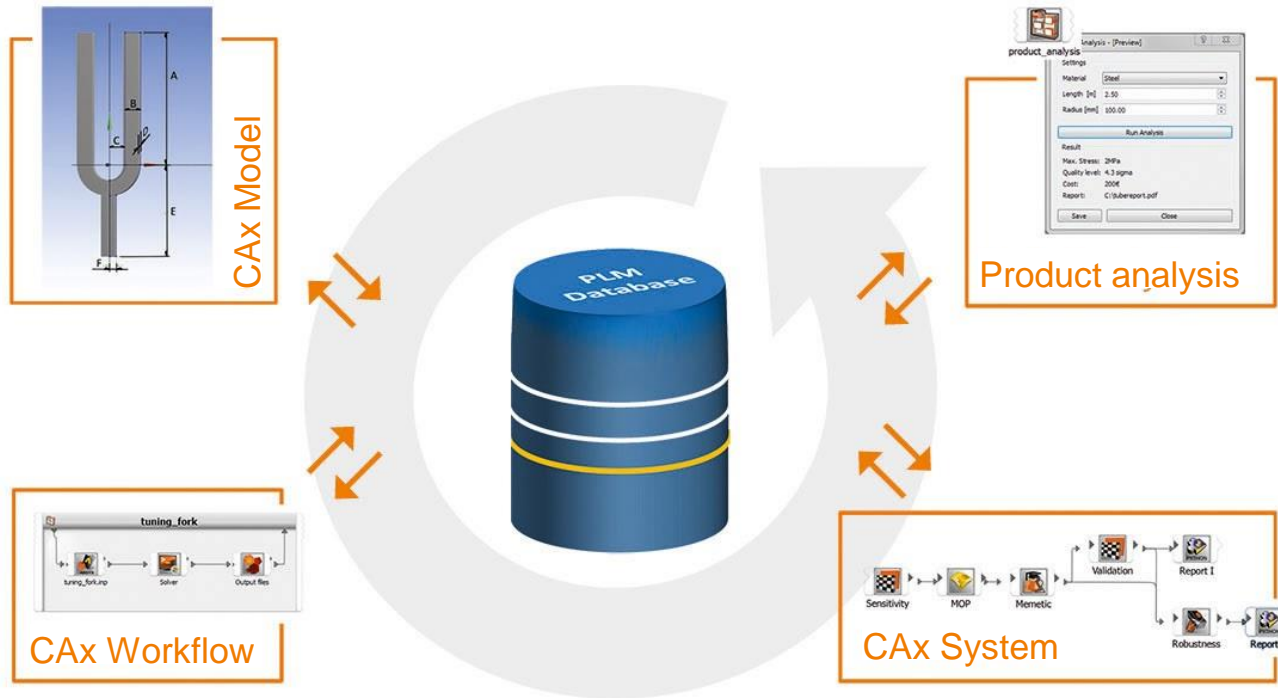
Democratization



- Product Analyst
 - Starts analysis
 - Parameter&Results are automatically stored for traceability

➔ Can be anybody of 3 prior groups or a „new“ person

Democratization



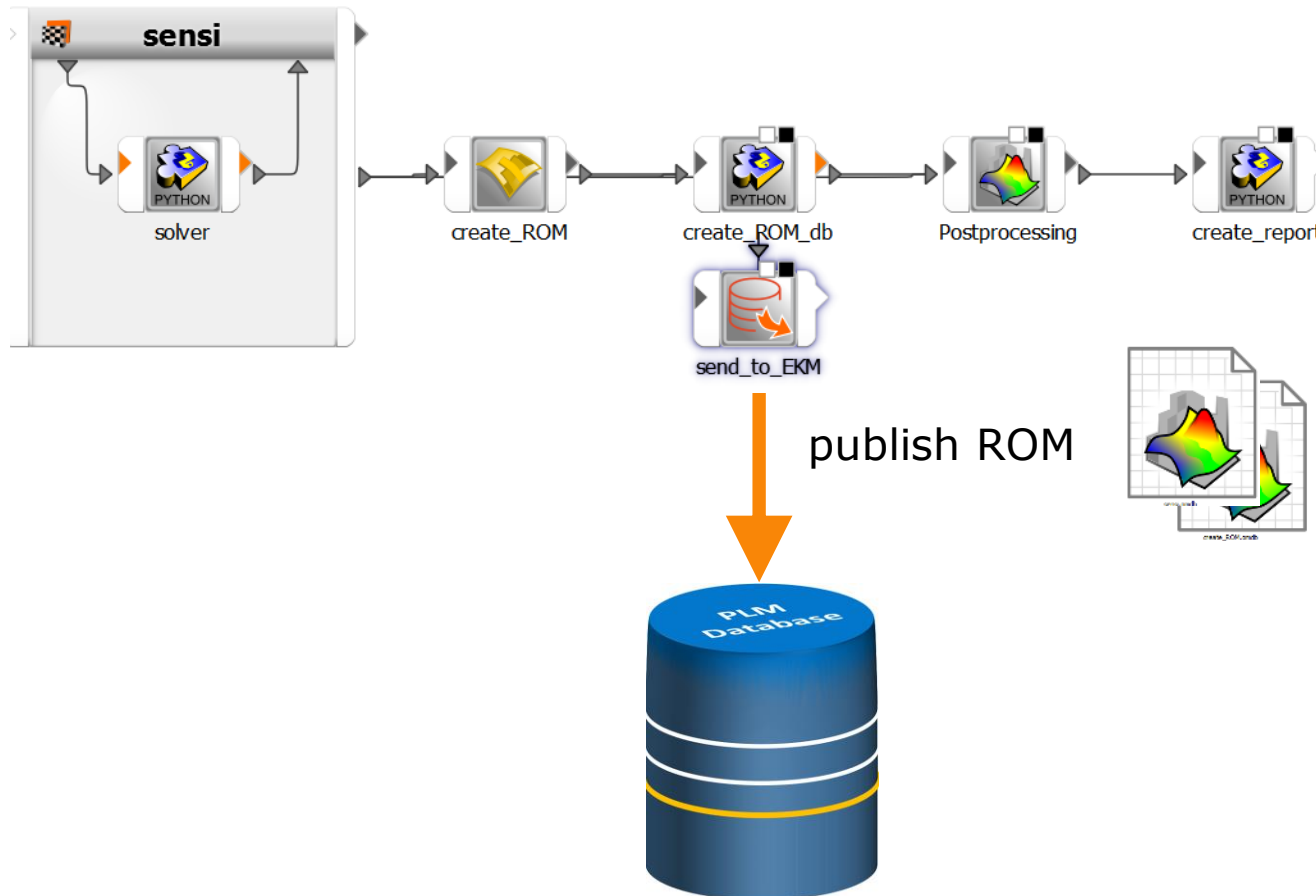
- Teamwork
 - Collaborativ
 - Flexible/Innovative
 - Traceable
 - Technically inherited quality assurance
 - Able to work at any point in time
 - Single person does not need to change way of work (a lot)
 - Continuous improvement

Operation



“We need operating parameters immediately”

- Workflow in optiSLang including MOP algorithm
- Creates fully automatic the data-based ROM (MOP) based on up-front simulations within a predefined variation space



→ Calibration workflow in optiSLang using e.g. SignalMOP

