Advanced Integrate with Ansys optiSLang and Mechanical Software

Powering Innovation That Drives Human Advancement

Introduction to Ansys optiSLang

Please note:

- These training materials were developed and tested in Ansys Release 2024 R1. Although they are expected to behave similarly in later releases, this has not been tested and is not guaranteed.
- The screen images included with these training materials may vary from the visual appearance of a local software session.

Release 2023 R1

Agenda

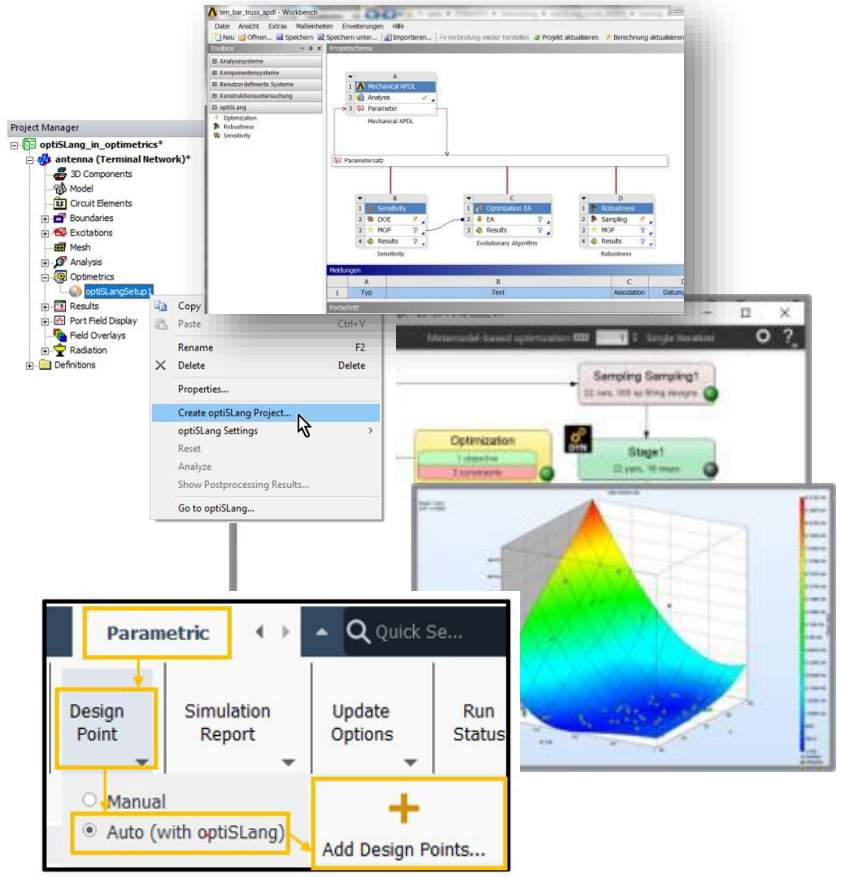
Session	Slide Set	Time	Topic
1	0	5’	Agenda
	1	**25’**	**Introduction to Ansys optiSLang**
		10’	Ansys optiSLang in the Ansys Learning Hub – Find your Examples
		15’	Q/A
	2	30’	Sensitivity Study and Optimization – Theoretical Background
2	3	75’	Hands-on – Process Integration, Sensitivity Study and Postprocessing Steel Hook – optiSLang inside Workbench
		15’	Q/A
3	4	40’	Hands-on – Optimization Steel Hook – optiSLang inside Workbench
	5	20’	Robustness Evaluation – Theoretical Background
	6	40’	Hands-on – Robustness Evaluation Steel Hook – optiSLang inside Workbench
		15’	Q/A

Process **I**ntegration and **D**esign **O**ptimization

Use optiSLang – Connect to Simulation

Embedded

direct use of algorithms



AEDT, Workbench, LS-DYNA

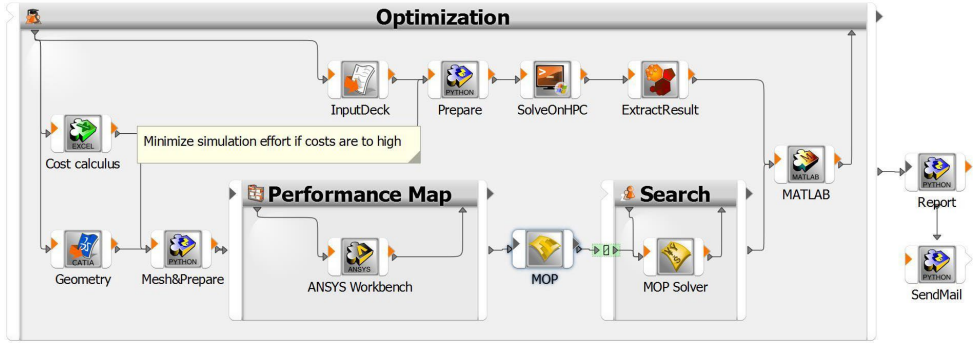
optiSLang GUI

connect tools & algorithms

Best in class connectors to
The Ansys tools
(incl. HPC licensing)

Direct plugins + open interfaces

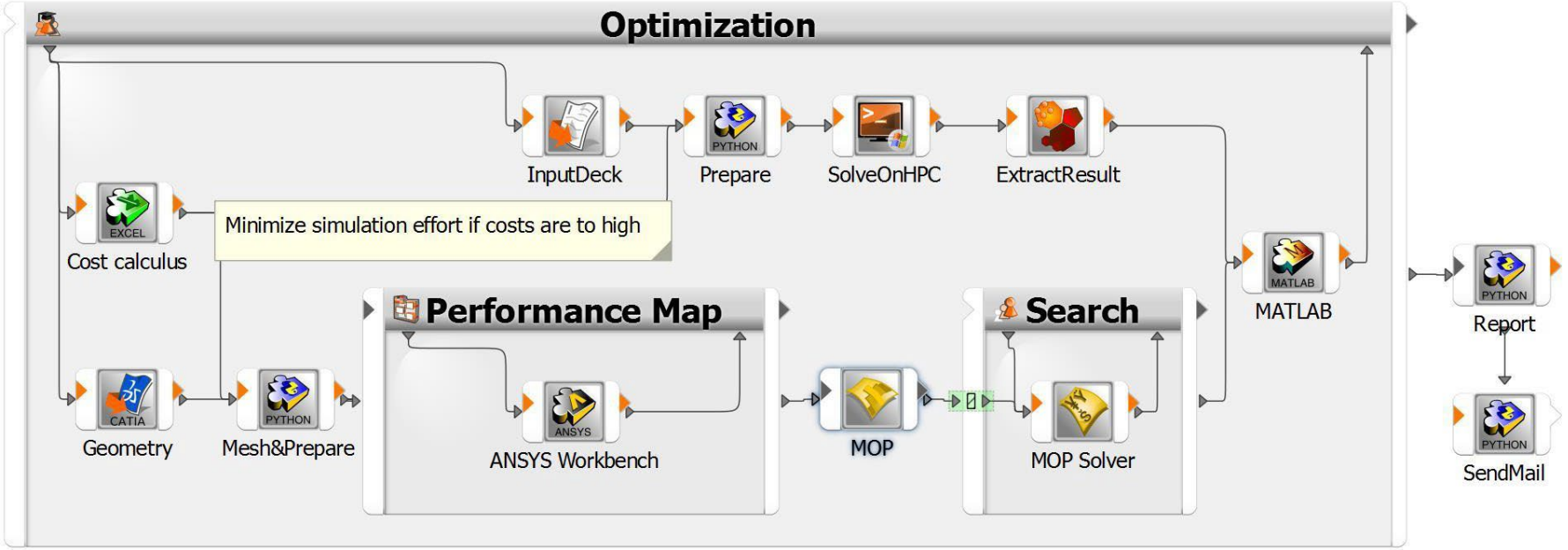
- ➔ 150++ propietary tools connected
- ➔ 100% vendor neutral



Linux/Windows, HPC&Cloud, Open API, GUI & Batch, …

Process Integration – Simulation automation

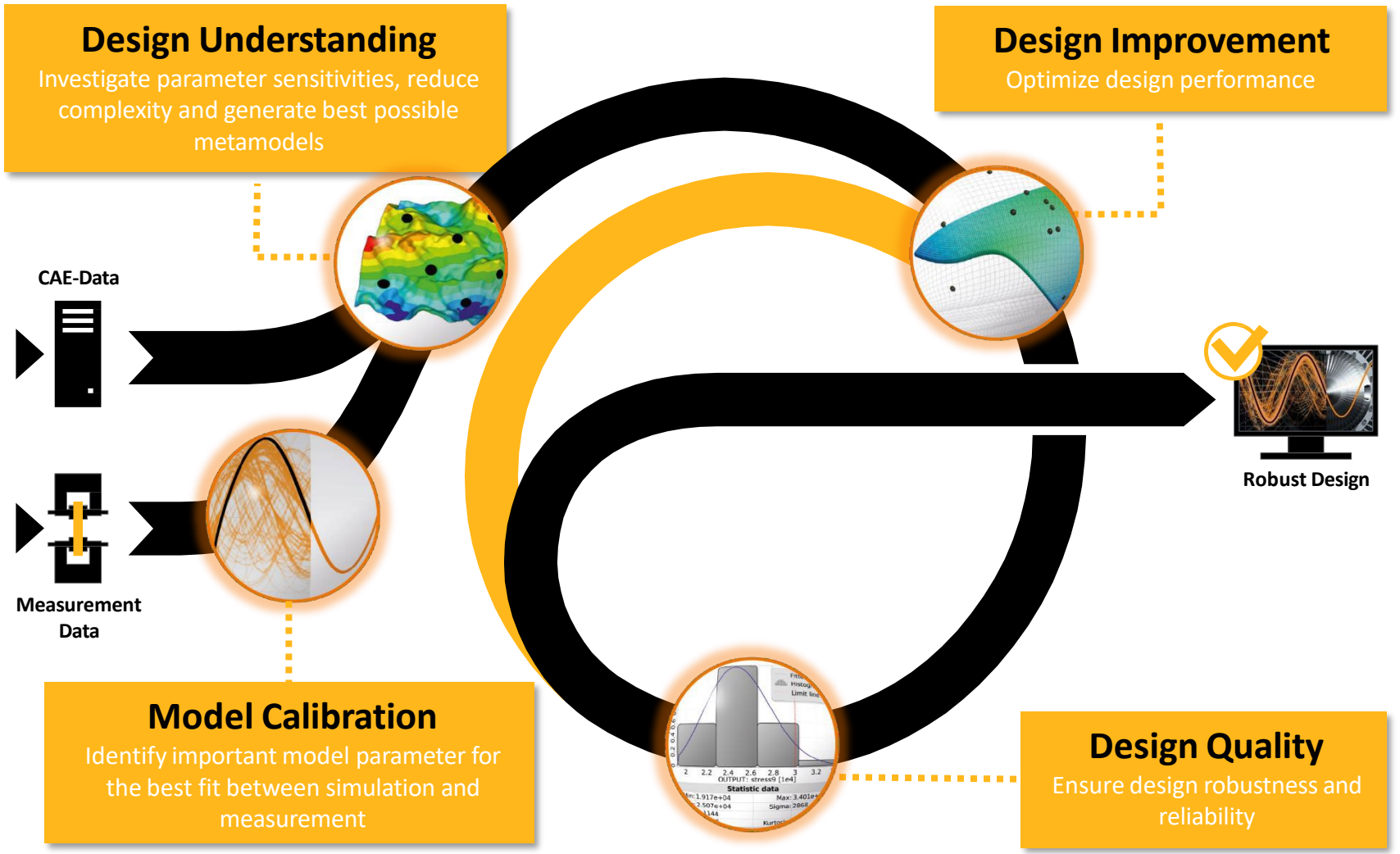
- optiSLang Integrations provide the flexibility to **build (parametric) workflows**
- Couple e.g. **Ansys Workbench** with other tools like **MATLAB, Inhouse Codes, 100+ commercial solutions**



- For orchestration use sequences, branches, conditions, loops, combination of algorithms …
- Flexible connect to HPC

Power Of Variation Analysis - Virtual Product Development

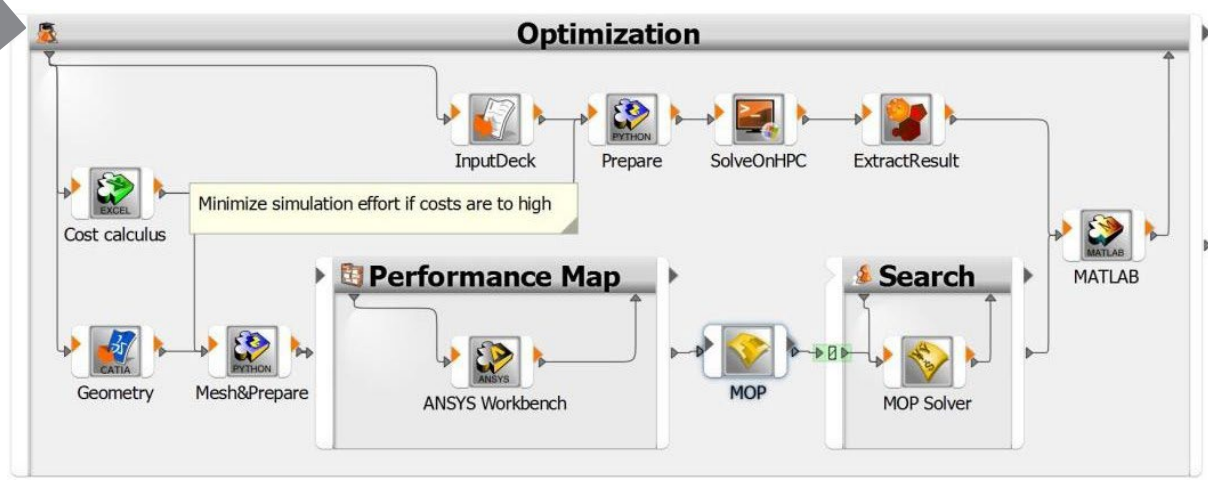
- **Fit/calibrate** simulation and measurement data for model qualification
- **Understand your design** via optiSLang sensitivity module
  - Which parameters influence what?
  - Which constraints and goal conflicts I need to address?
  - Can I calibrate to measurements?
- Powerful metamodeling module
- Find the **best design** based on your goals and limitations
- Powerful **Robustness/Reliability**
- Enables customer to address Robust Design Optimization (RDO), Uncertainty Quantification (UQ), Design for Six Sigma (DfSS)



Details

optiSLang connects ...

- Connect the tools our customers use
  - Ansys Software
  - 3rd party
  - PLM
  - In-house
- CAx workflow management
  - Organize sequence/loops/conditions
    DOE, optimization, performance grid
- Open architecture
  - Plugins
    for CAx Tools, Algorithms, PLM/Databases
  - Interfaces
    Batch, Scriptable, Remote control

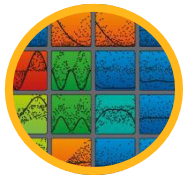


DoE & Sensitivity Analysis

Ansys / OPTISLANG

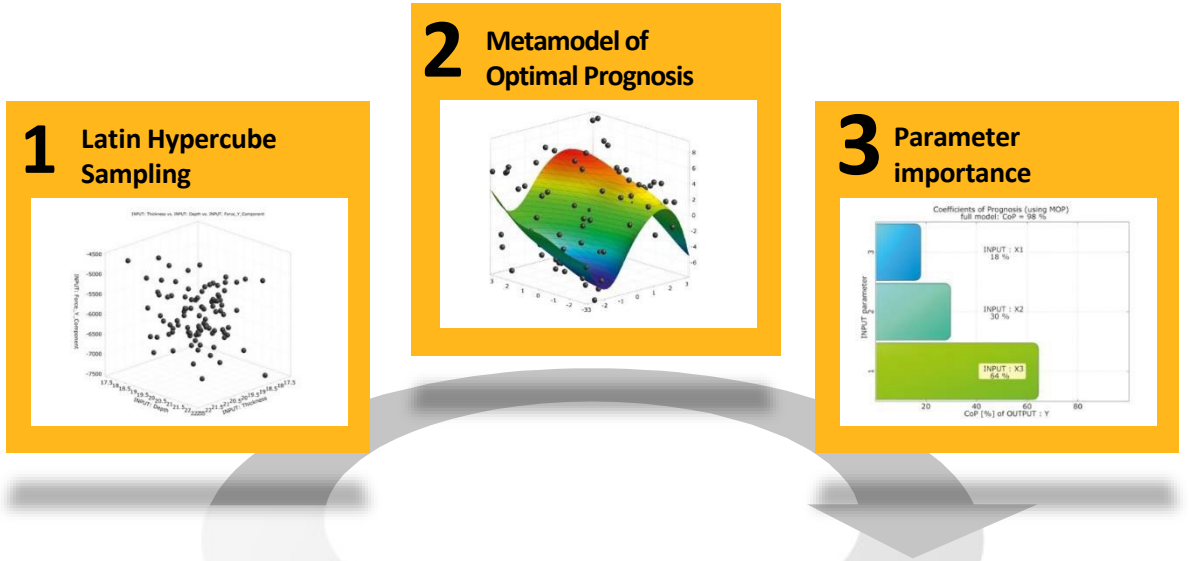
Understand your possibilities:

- Take a deep look at the **space of opportunities**
- Learn which design parameter is important and how to define the goals and the limitations to **find the right way**



Sensitivity Analysis

Understand the most important input variables



Automatic workflow with a minimum of solver runs to:

Identify the important parameters for each response

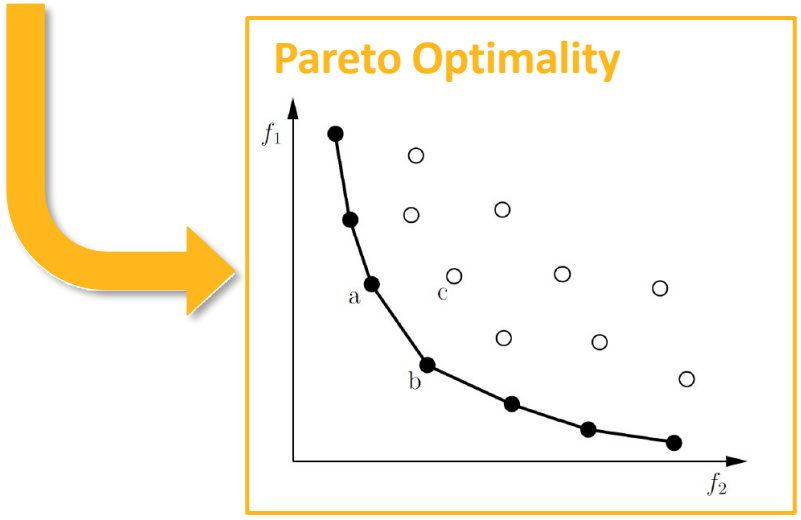
Generate best possible metamodel (MOP) for each response

Understand and reduce the optimization task

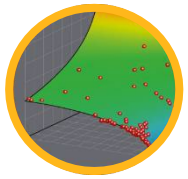
Check solver and extraction noise

Design Improvement

- How to define your objective?
- Use the MOP from Sensitivity to compare different optimization strategies in minutes (no simulation run)
- Do you have constraints?
- One goal or maybe multi disciplinary optimization?

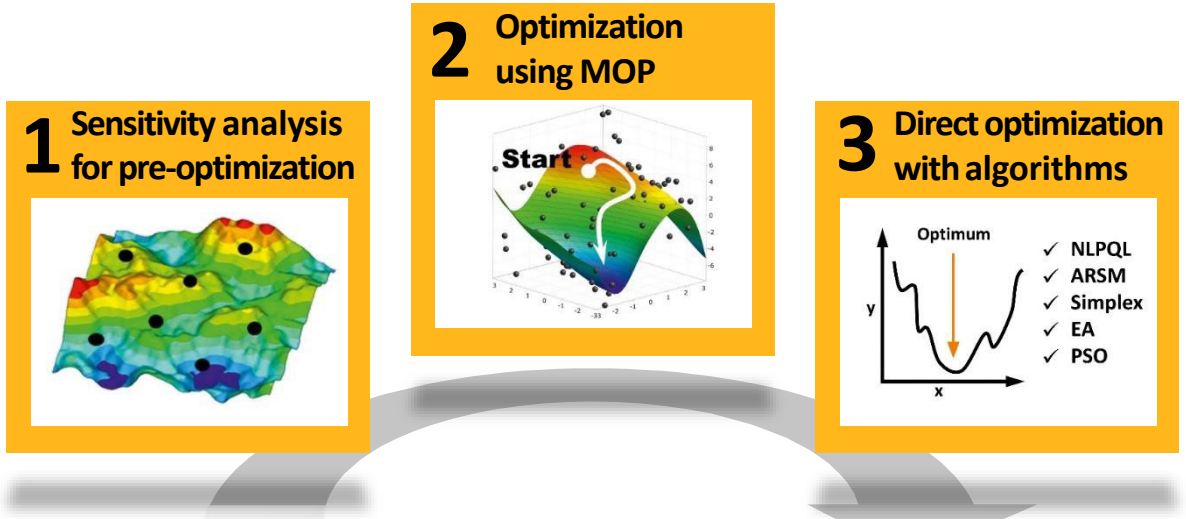


Ansys / OPTISLANG



Optimization

Optimize your product design



Work with the reduced subset of only important parameters

Pre-optimization on meta model (one additional solver run)

Optimization with leading edge optimization algorithms

Decision tree for optimization algorithms

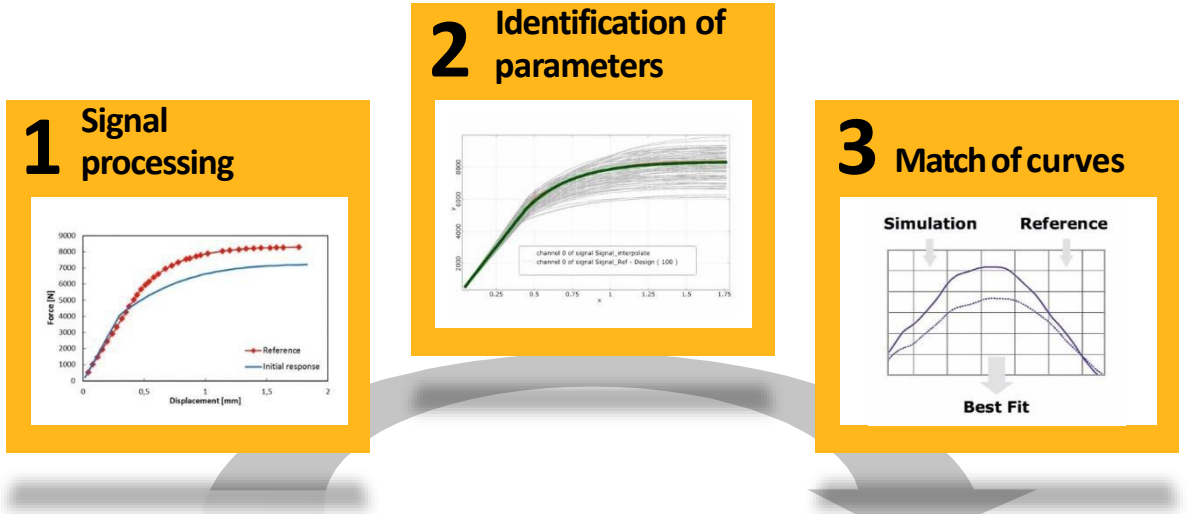
Parameter Identification

Ansys / OPTISLANG

Model Calibration

Model update to increase your simulation quality

- How good fits your simulation to measurements?
- Do you need to qualify your model?
- Do you have unknown parameters?
- Automatic calibration incl. curves
- Possibility to test different model definitions (from simple to complex)



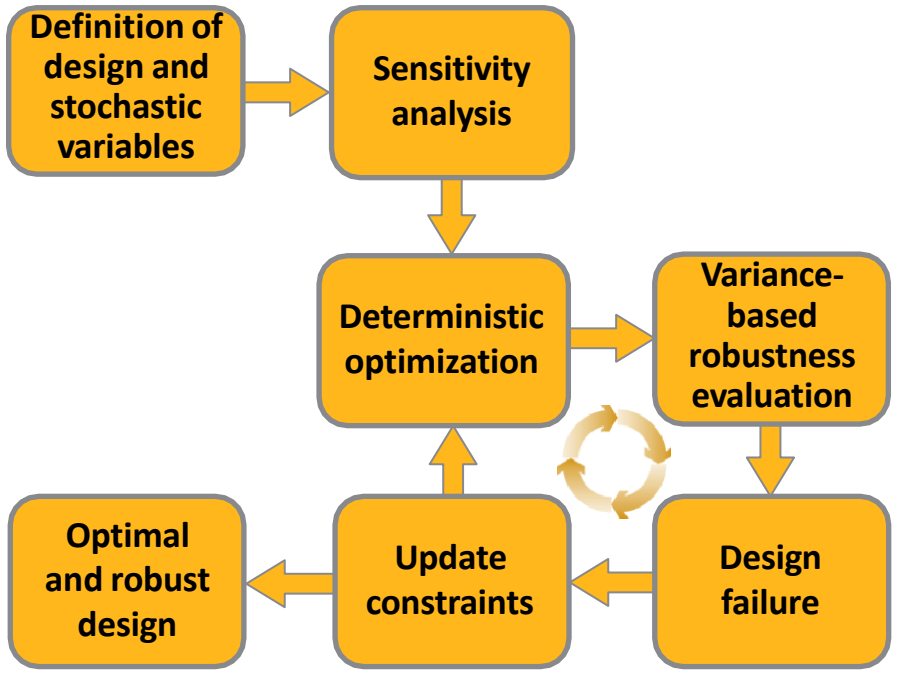
Use scalar values or signals inside Ansys Workbench

Identify which parameters have influence and can be calibrated

Match experimental data with simulation

Design Quality

- For each optimization run the safety factors are adjusted for critical model responses
- How big are the influences of tolerances from material, geometry and production

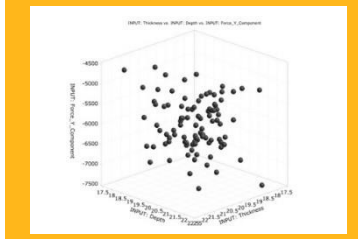


Ansys / OPTISLANG

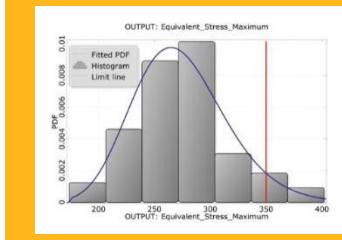
Robustness Evaluation

Ensure your product quality

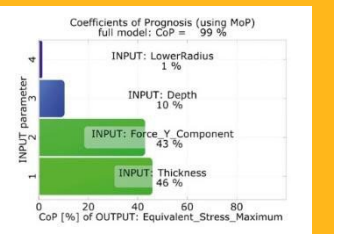
1 Latin Hypercube Sampling



2 Output parameter variation



3 Parameter Importance



Powerful procedure to check design quality:

Robustness evaluation with optimized Latin Hypercube Sampling

Proof of Reliability with leading edge algorithms

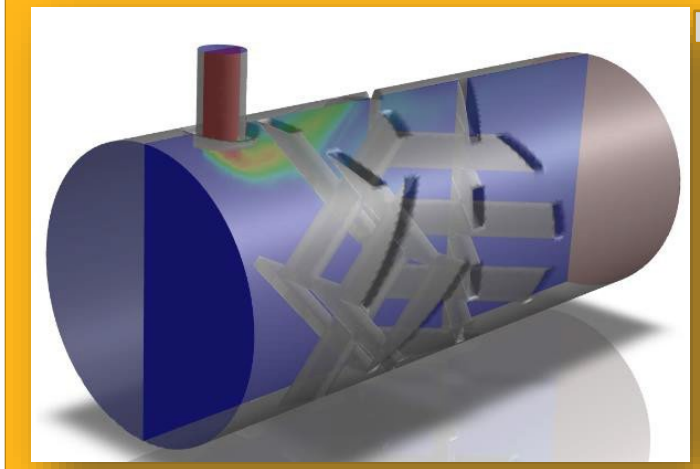
Check variation interval limits and probabilities of overstepping

Identify the most important scattering variables

Decision tree for robustness algorithms

Democratize Workflows –> Calculate & Postprocess in oSL-App

Simulation Expert



Mature CFD simulation

- Past troubleshooting stage
- Confident case will run on first try

Programming Expert

Custom Programming

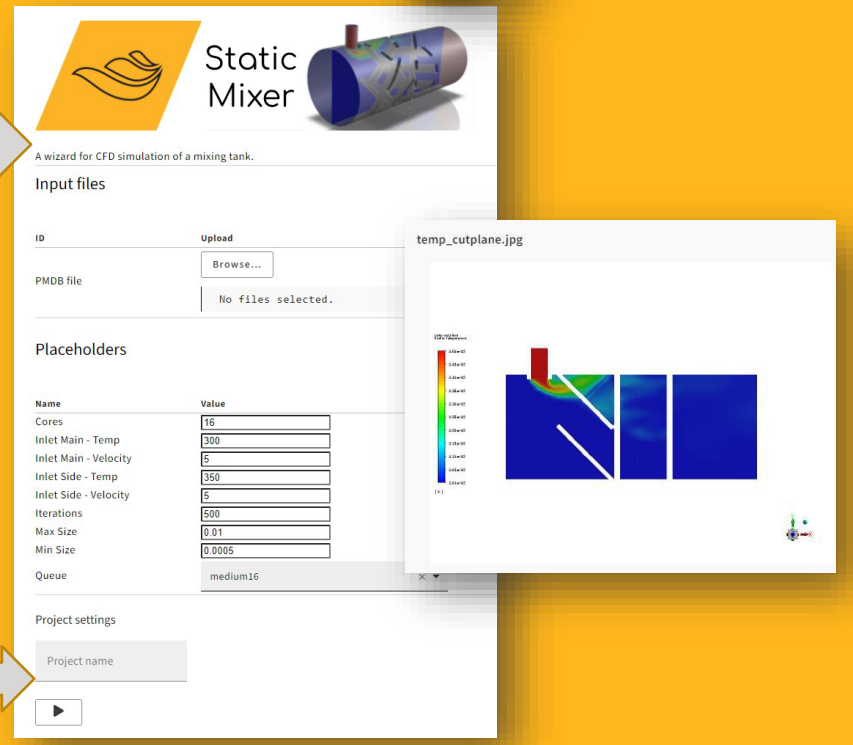
- Expensive and time-consuming to develop
- Hard to maintain (ACT + scripting)

optiSLang Novice

GUI-based Workflow

- No programming required
- Easy to learn and fast to develop
- Easy to host on network

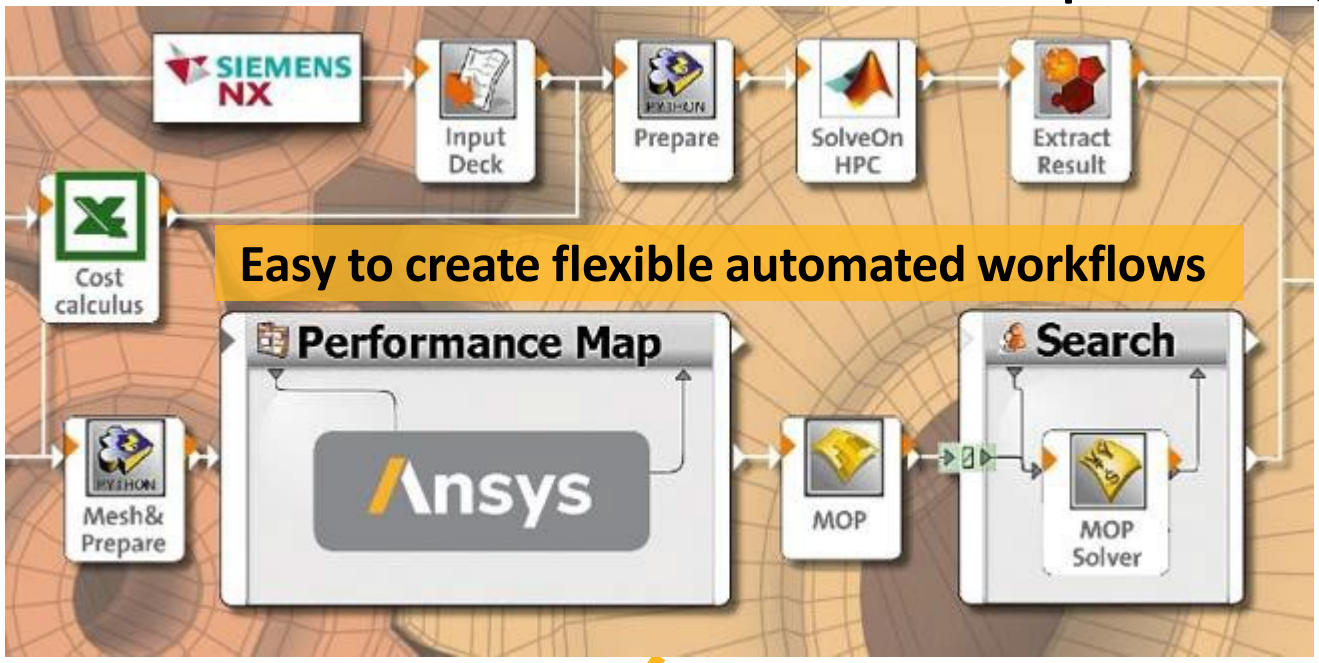
Non-simulation Expert



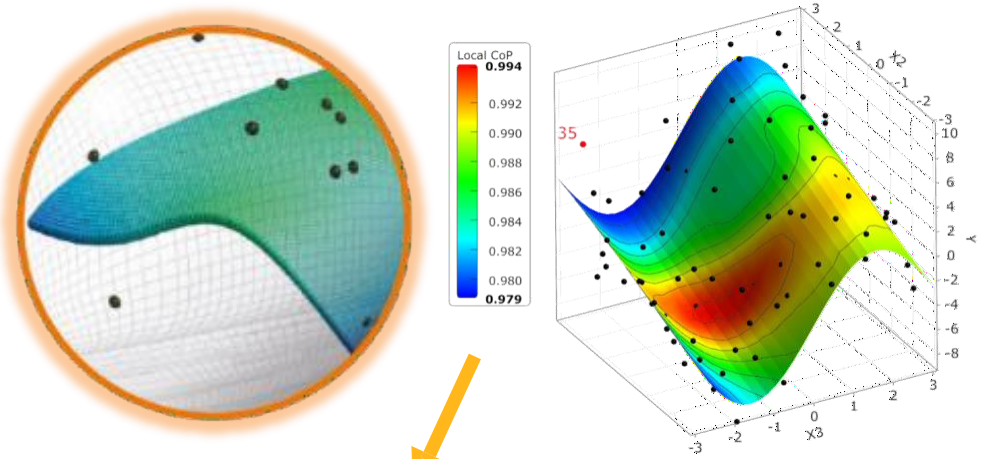
User-friendly Tool

- No simulation experience required
- No need to have software installed
- Available on network

Simulation Orchestration with optiSLang App



Compress the Knowledge/Results from design studies in forecastable response surfaces.
It is called **R**educe **O**rder **M**odel (ROM) or **M**etamodel of **O**ptimal **P**rognosis (MOP).
Use this to forecast new design variants.



Publish Workflows

- Easy access of pre-defined workflows
- For internal colleagues
  (e.g. simulation experts or product experts)
- Req: previously created optiSLang **Workflow**

Publish Results

- Fast pre-calculation with „What if“ studies
- For internal colleagues & external customers
  (simulation experts, product experts or consumers)
- Req: previously created **Results = ROM/MOP**

Licensing

Ansys optiSLang

Capabilities	Pro	Premium	Enterprise
Design Studies			
Classic DOE	✓	✓	✓
Sampling & Sensitivity Analysis	✓	✓	✓
Robust Design Optimization	✓	✓	✓
Classic scalar meta-modeling	✓	✓	✓
Reliability Analysis		✓	✓
Process Integration and Workflow Orchestration			
Embedded in Ansys + LS-OPT*	✓	✓	✓
Build and automate workflows		✓	✓
Integrate 3rd party tools		✓	✓
App generation			✓
Advanced Meta Modeling & AI/ML			
Field meta-modeling (signals, 2D/3D)			✓
UQ for signals, 2D/3D			✓
AI/ML for RDO			✓
Concurrent Solver Variant Licensing			
Solver variations for parametric design study		**+3**	**+7**

optiSLang Pro

Get attracted to design studies
Offer unlimited Sensitivity Analysis, Robust Design Optimization, all from within the applications they are accustomed to using.

optiSLang Premium

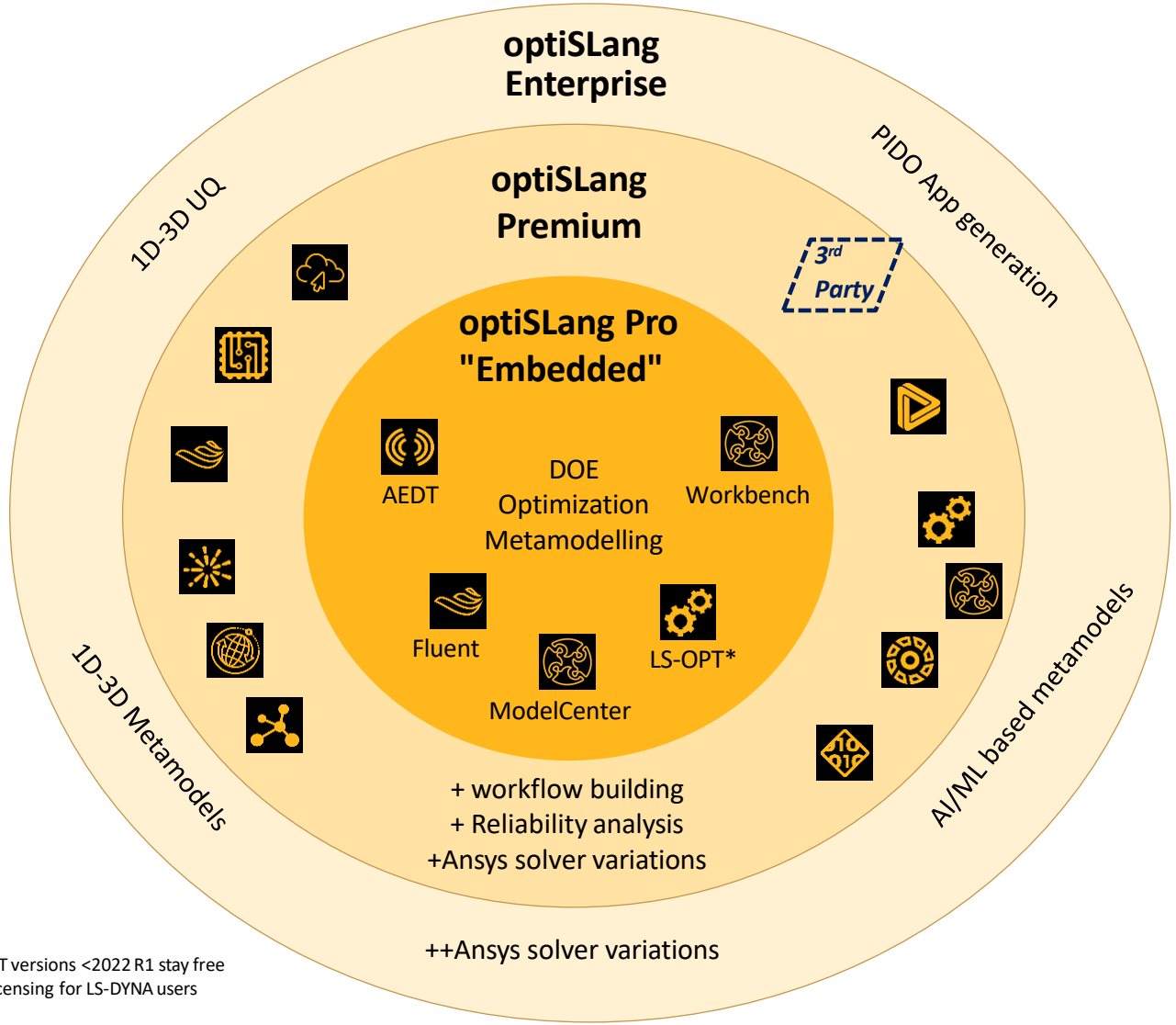
Win the workflow
Accelerate engineering design studies by automating workflows with 3rd party tools and maximize customer ROI.

optiSLang Enterprise

Scale parametric design studies
Add advanced reduced order modeling and AI technology and deploy workflows across the engineering organization via Apps.

*LS-OPT versions <2022 R1 stay free from licensing for LS-DYNA users

optiSLang licensing - grows with usage & learning



*LS-OPT versions <2022 R1 stay free from licensing for LS-DYNA users

Start „optimization“ directly in Ansys CAE environment

- Easy to use
- Wizard guided
- Pro licensing for different physics
- Share across team – build optimization know-how

More complex workflows

- Multi-disciplinary
- Include non-Ansys and inhouse tools
- More HPC & Cloud computing options
- Use Ansys concurrent licensing

Algorithm and Workflow Expert

- AI/ML based metamodels
- 1-3D Metamodels
- 1-3D Uncertainty Quantification
- Publish workflows for Minerva, MBSE, …

PIDO Customer Journey – starting from Flagships

- Promote parametric studies within Ansys parametric design environment
- Customer has modest investment

- Add Premium for process integration and workflow automation
- Customer benefits from workflows covering Ansys, 3rd party, ..

- Add Enterprise for AI/ML & field meta modeling
- Create Apps and Connect to MBSE, SPDM & HPC/Cloud

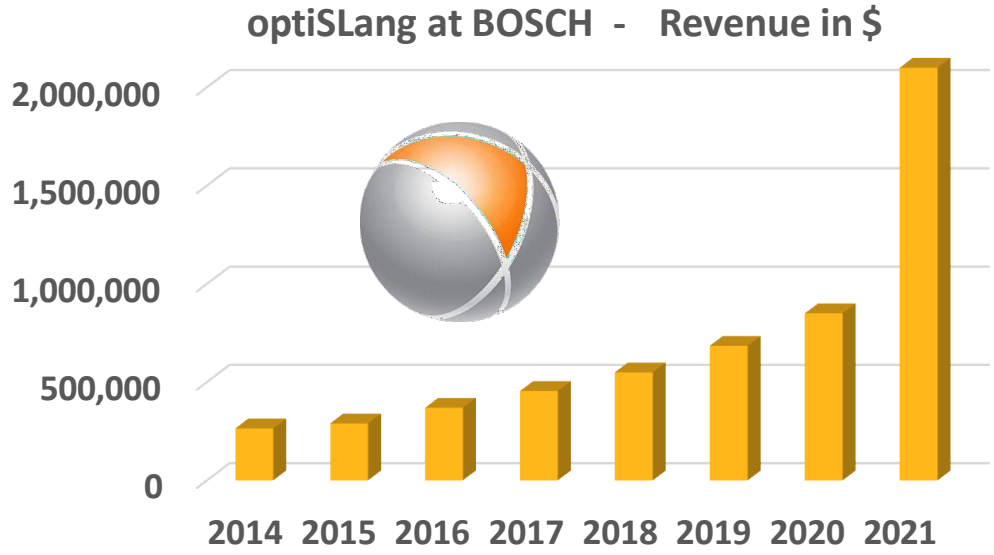
Concurrent licensing supports parametric design studies

Success

From Sales to Sales - optiSLang Value Proposition

Benefits of Ansys optiSLang for you:

- " Increase Solver usage "
  - ➢ More revenue
- " Move from point solution to process solution (multi design & multi physic) "
  - ➢ Increase reputation, raise any competitive discussion to a higher level
- " Add additional user levels like designers or Non-Sim-Experts by automated workflows remote access from web-apps "
  - ➢ More licenses
- " Better products by optimization "
  - ➢ Increase reputation of Ansys and yourself
- " Tolerance analyses for more reliable products "
  - ➢ Increase robustness & trust of simulation



optiSLang Drives Solver & HPC

Customer Goals

Workflows for design optimization:

- Understand the influence of variability
- Combine functional and profit optimization
- Automate workflows & publish as apps
- Minimize development time

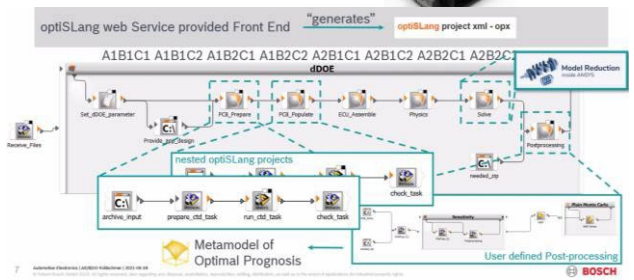
Solution

- optiSLang wins the workflow of parametric design evaluation
- finds the most important parameters and drives design studies
- Replace third party workflow components

Benefits

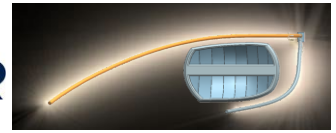
- **One** optiSLang drives **hundreds** of designs for optimization & tolerance analysis
- **One $** optiSLang drives at least **three $** additional solver/HPC
- Customer **standardized on optiSLang workflows** show **dynamic growth**, having **>10%** overall revenue with optiSlang (2021 BOSCH oSL 2.1 mio with overall ACV 17 mio and +40% new business driven by optiSLang+TechPool)

BOSCH

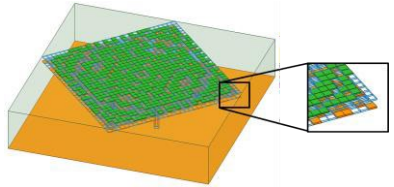


ECU digital twin maker workflows and apps driving M+F+EBU solver and HPC

MAHLE



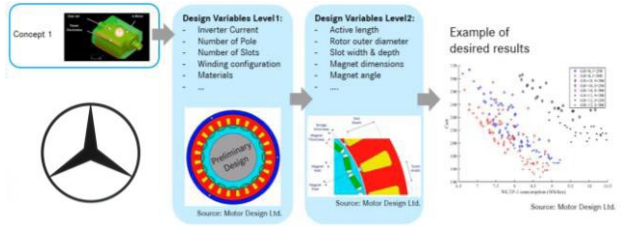
Headlamp lightguide optimization workflow drives Speos



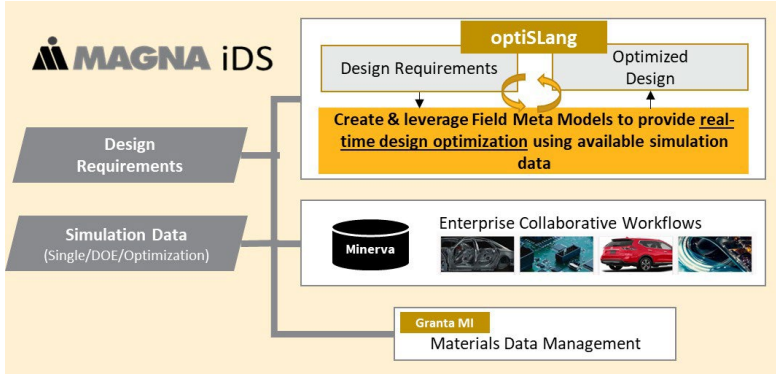
Pixel antenna optimization workflow driving HFSS *replacing CST*

GlaxoSmithKline

autoinjector optimization optiSLang driving SpaceClaim & Ansys-LS-Dyna *replacing Abaqus/Isight*



E-Motor concept development workflow driving Motor-CAD/Maxwell/Mech



Intelligent Design Space workflow uses upfront simulation for optimization driving LS-DYNA

Ansys optiSLang Drives Additional Ansys solver and HPC business

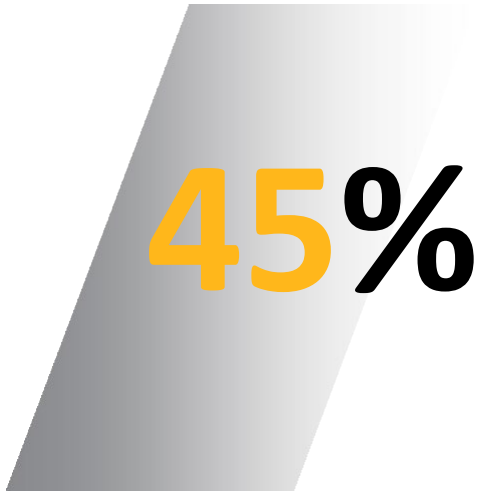
1$ oSL = 4.6$ additional Ansys (3.5 … 5$)

Proof Points:

customer	optiSLang revenue new	additional revenue Ansys new	description	Factor additional business driven by optiSLang
Black&Decker, 2022	86k$	330k$	MYD: $86k optiSLang + approx. $330k additional revenue through HPC, LS-DYNA, CFD, Mechanical driven by optiSLang	3,8
Trumpf, 2022	40k$	>126k$	Trumpf workflow where we have proven to have driven Zemax (?), Ansys CFD (60k) + FEM (40k) + HPC (26k) with an optiSLang license (40k)	3,2
Bosch, 2021	1.5Mio $	3.8Mio $		2,5
Maier,	20k$	47k$	New business is 20k (pure optiSLang) + additional 1 Speos with 47k (a	2,4
gsk, 2021	33k$	76k$	Evaluation Deal: $33k optiSLang + $56k HPC + $20k LS-DYNA	2,3
Porsche, 2021	1$	8$	Multi- Disciplinary –Optimization Each of these Parameter studies submit between 5 to 200 LS-Dyna simulation simultaneously -> 1 $ optiSLang orchestrates 8$ Solver - Business	8,0
Danfoss, 2021	1$	2,5$	The TopTen users of optiSLang accounts for 4% of the total user base @ Danfoss These TopTen users were using ~8% of the available simulation resources Active optiSLang users are top consumers of simulation licenses, they are using 2x more simulation "units" than the average user!	2,5
OPTISYS, 2019	35k$	215k$	optiSLang, HFSS, HPC Task - Connect Ansys AEDT to their optimizer in Excel and automate the process	6,1
Boston Scientific, 2020	35k$	65k$	optiSLang, LS-DYNA, HPC Task – Automate optimization of geometry using LS-DYNA Simulations	1,9
ON Semi 2019	35k$	140k$	4 Optislang @ $35K = $140K and 10 Mechanical @ $50K= $500K	4,0
Seatle 2019	1$	15$	After winning the workflow with optiSLang+Comsol, the majority was converted to Maxwell, 1$ optiSLang won 15$ Maxwell.	15,0
CADFEM	1$	3$	CADFEM statistics shows a multiplier of 3	3,0
			mean value Factor	**4,6**

Positive Business Outcomes of optiSLang

More projects

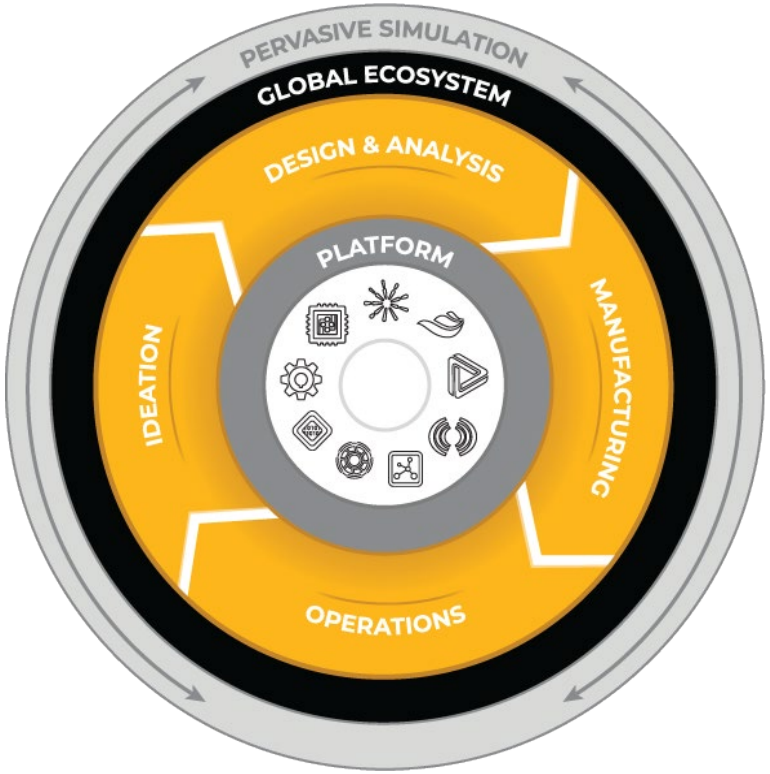


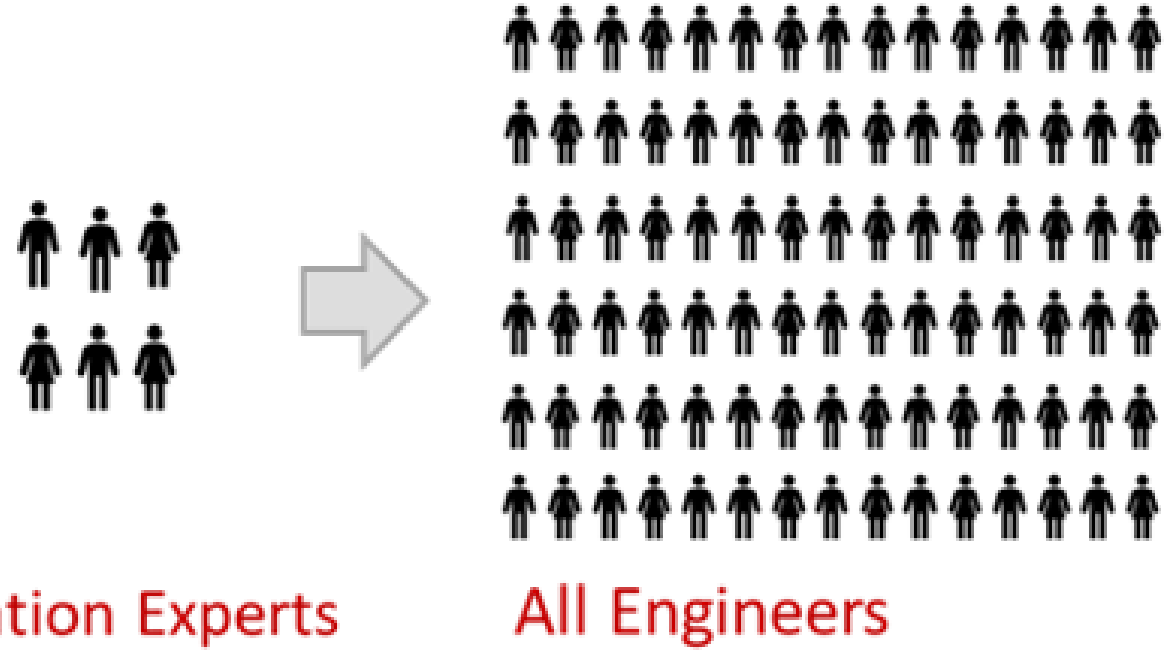
Saved Engineering Time

Lowered Design Cost

Simulation Democratization

Democratize simulation to be used or consumed by many engineers
in different stages of the development process





Automation & Democratization

2.5X

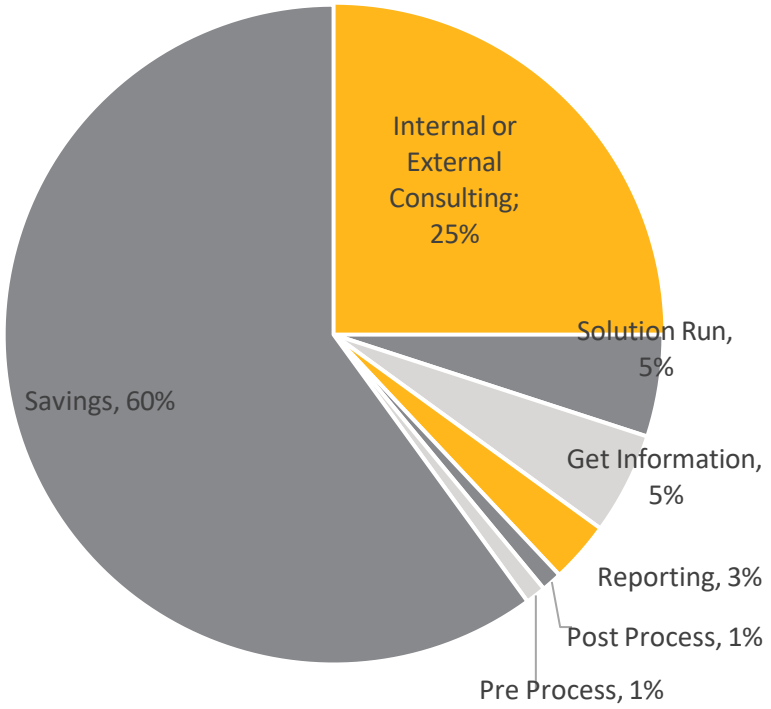
Automation

(incl. database)

CAE Engineer time savings

- Process: 45%
- Get info: 15%

➔ Can simulate more 2,5x



10x10x

Democratization

Worldwide:

- 750k CAE Engineer
- 8M CAD Designer
- 800M Excel user

➔ Simulation for Non-SimExperts


Ansys