



**Real World Applications for
Simulation Workflow Management
combined with
Simulation Data Management**

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Outline

- Customer: goals & challenges
- “Background” PIDO – tools
- Connect to Database = “just another process integration”
- Simulation workflows: Democratization
- Collaborative work

Customer



goals & challenges

Customer goals

- Traceability / Liability
CAD + Simulation + used Postprocessing ...
- Cooperation
Reuse Models and Processes to avoid duplicated work
- Quality assurance
Standardized, revisioned, comparable simulation processes + results
- Automatization
Simulation for non-experts
Shorter Iteration loops in PDP
- Usability
Graphical programming + commercial interfaces
replace fragile "self-made" solutions
- Flexibility
Create Workflows as you go
no static processes

Customer challenges

- Number of Simulationtools

100+ tools

- Datamanagement

Size of data (100-1000x CAD)

Different destinations / different ways to save data

- Speed of Innovation

Many different products

Short cycles

- Complexity

Different databases (Material, Loadcases, Requirements, ...)

Simulation processes

Business workflows

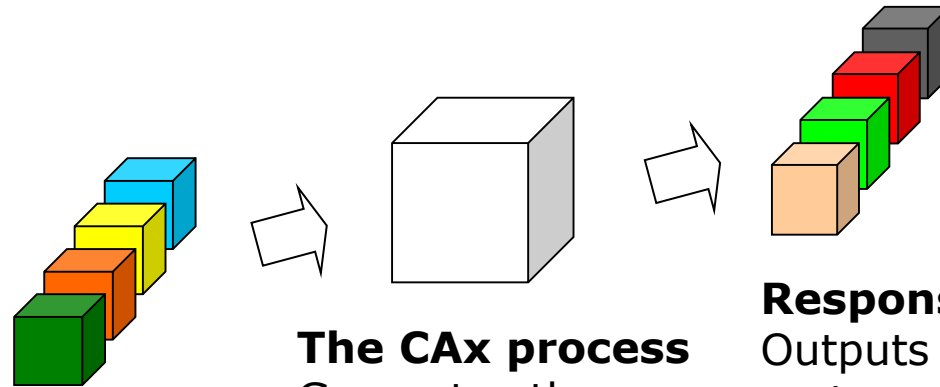
- ...

Process Integration &



Design Optimization

Variation analysis (CAx)



Variables

Entities that define the CAx model

The CAx process

Generates the results according to the inputs

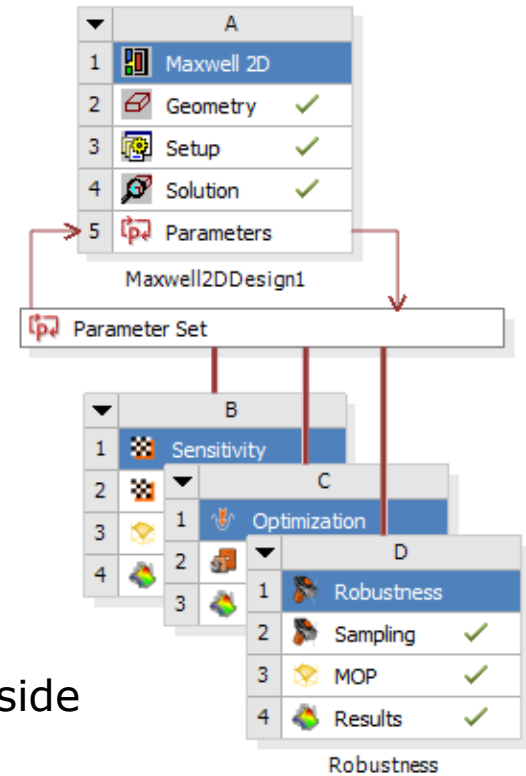
Response variables

Outputs from the system

"old style": scripting of process chain
→ *need experts*
→ *not scalable*

Parametric Modeling Environment

- Define inputs + outputs in the CAx tool
- Perform Variation analysis... in the CAx tool
 - ANSYS WB
 - AMESim
 - Catia
 - Excel
 - Matlab
 - ...
- Most offer connection for automatization from outside
- Standardized connection
 - reduce scripting ...
 - ➔ This is what Process Integration tools use



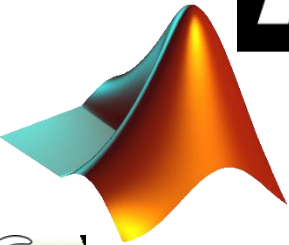
PIDO – tools organize/maintain connectors dynamdo



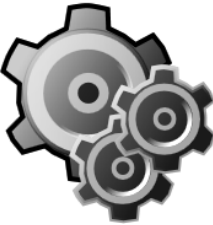
Zemax



Powered by ITI



madymo



MSC Software Adams

VCollab

GT Gamma Technologies

CONCEPTS NREC

TurboOpt



PuTTY

Midas Edyson

Flux Menor Graphics FloEFD

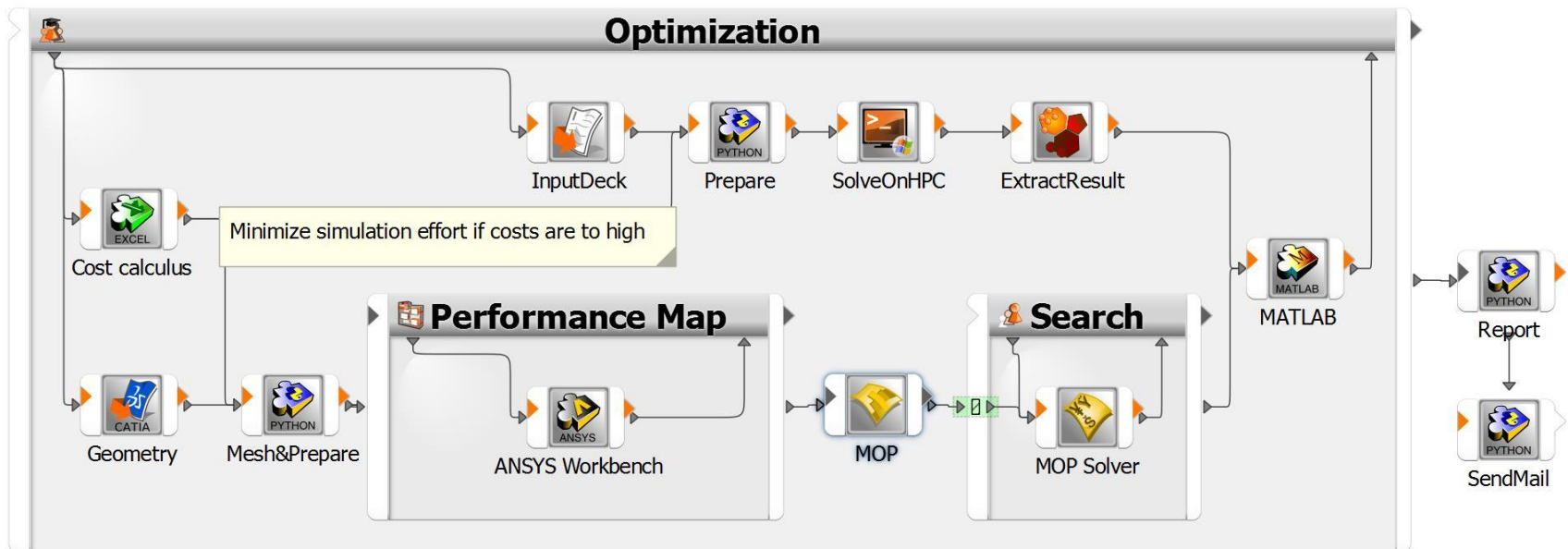
GEO DICT



+ Custom Plugins 9
= more than 100 tools

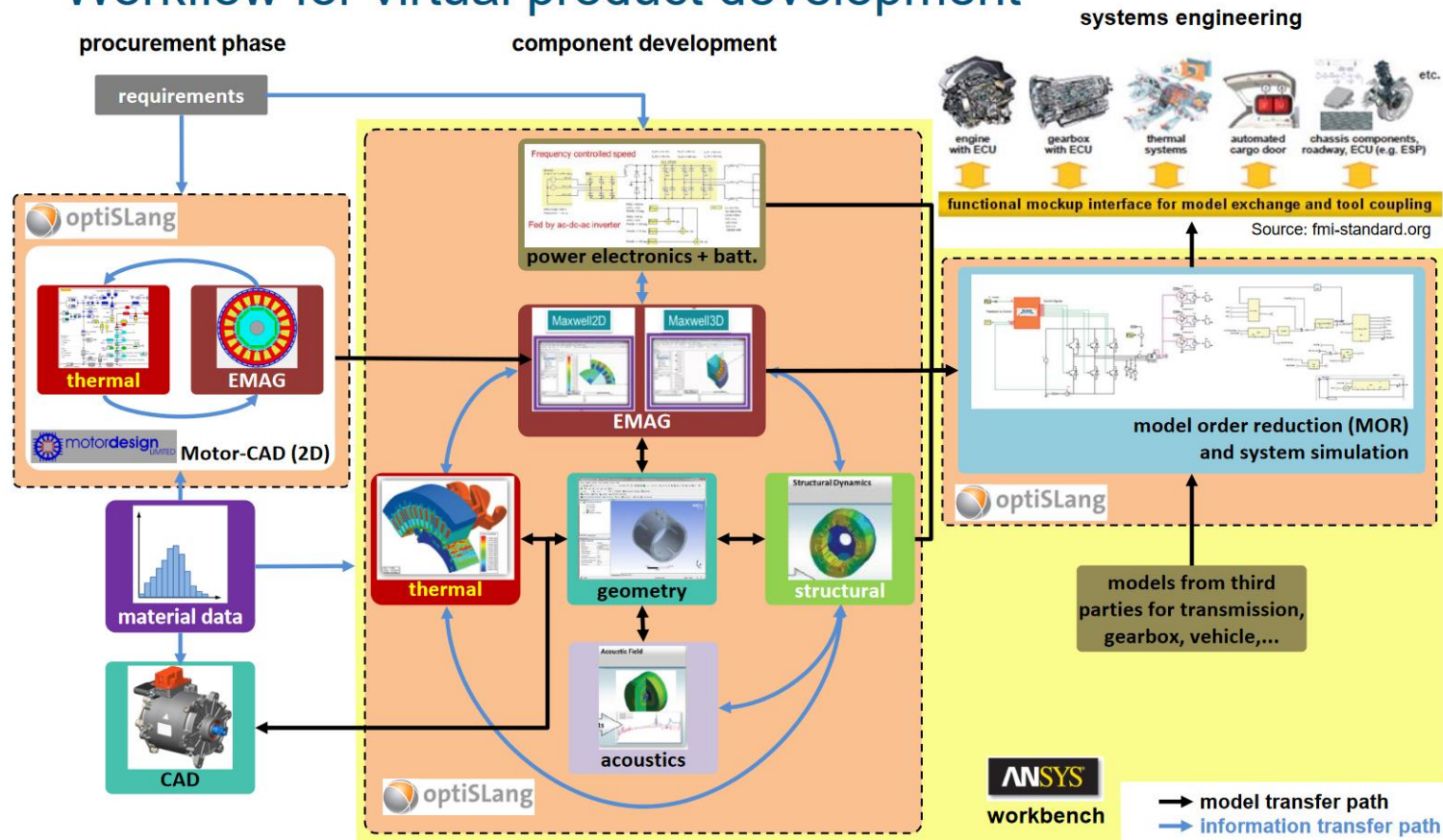
Simulation workflows

- Graphical programming (extremely reduce scripting, re-use knowledge, ...)
 - Combine different tools
 - flexibility to build parametric workflows integrating arbitrary CAX tools
- run design variations automatically



optiSLang driven workflows in procurement, component development and systems engineering

Workflow for virtual product development

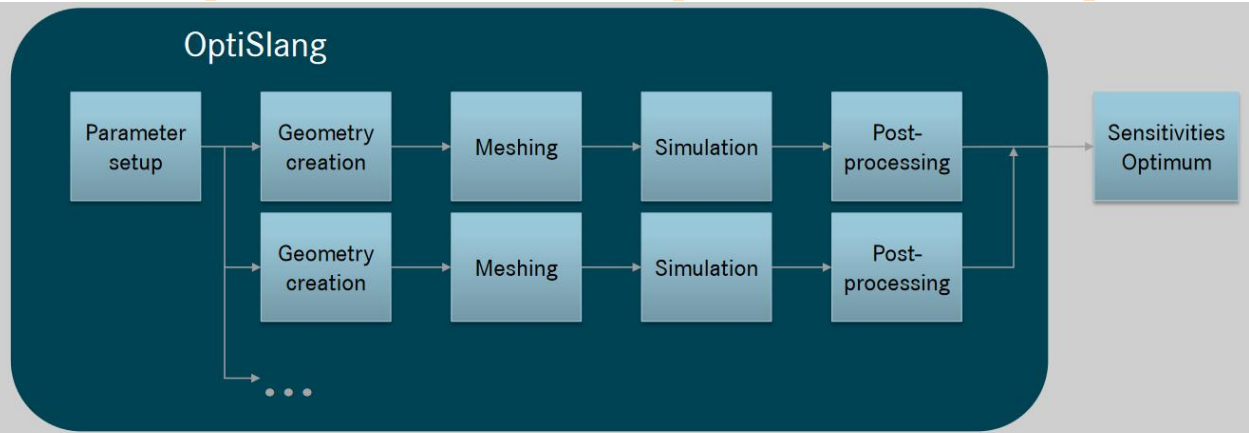


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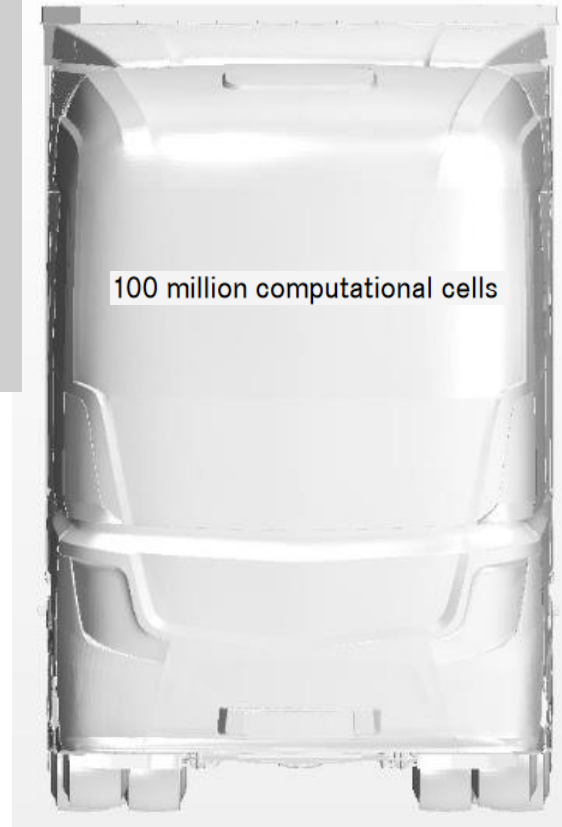
optiSLang driven workflows in procurement, component development and system engineering



Software-Tools:



Truck aerodynamics



➤ Resources:

Pre- / Post Processing : min. 200 GB memory

Per simulation about 2 days on 400 cores

9 parameters: 200 CFD runs

**Total amount of data per sensitivity analysis :
approximately 8TB**

Connect to database



“just another process integration”

Interface PDM/PLM inside optiSLang



Product parameter

Name	Resolution	Range	
X1	Continuous	-3.14	3.14
X2	Continuous	-3.14	3.14

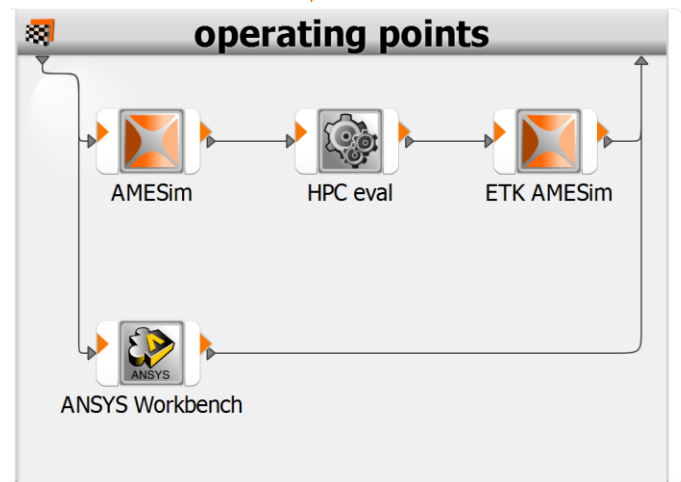
Name	Left side expression	Criterion	Right side expression
X3	Constraint	Y	≤ 10



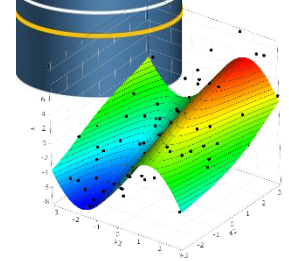
CAE Model



CAE Model



Results



Customer

- Different data sources
 - CAD
 - Material
 - Requirements ...

→ not all can be merged into one Database (political/technical background)

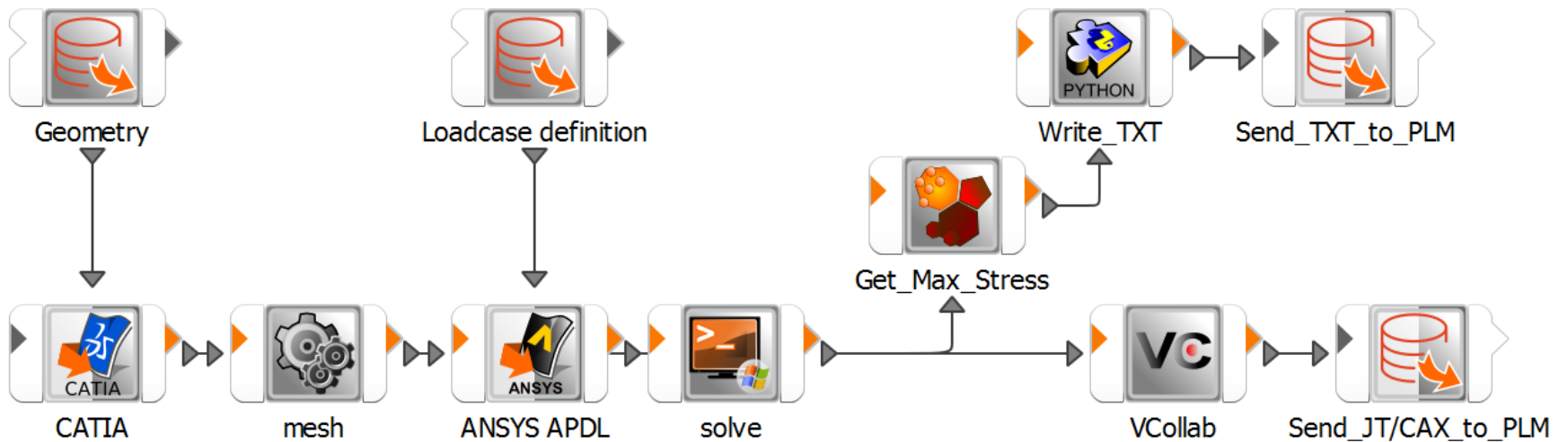
- Different data sinks
 - Report
 - Simulation data ...

(only one sink will end up in endless discussions → delay of rollout)

Customer asks:

“Isn’t a checkout / checkin not somehow comparable to a solver call?”

Interface PDM/PLM inside optiSLang

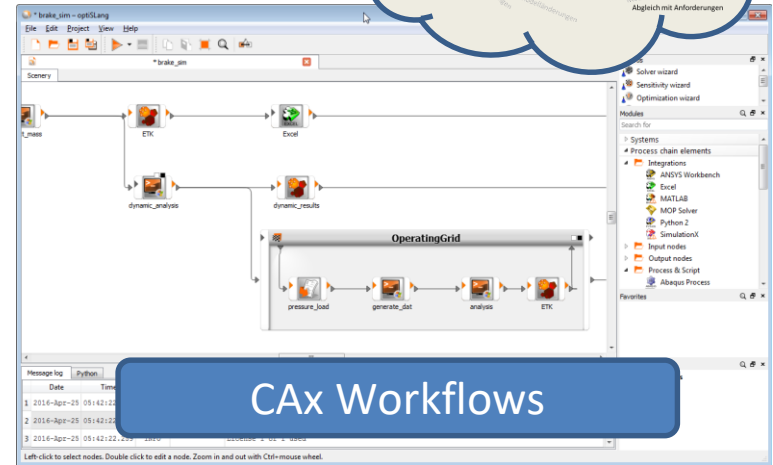
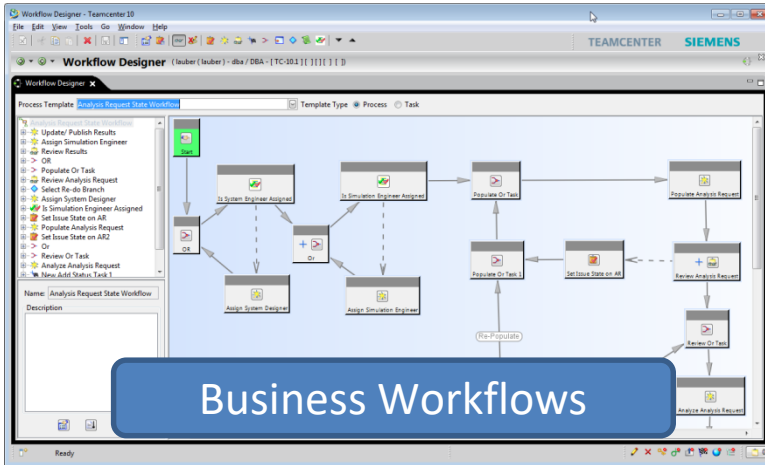
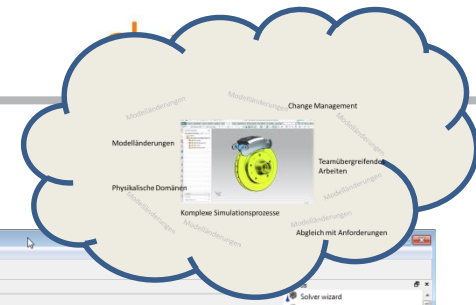


Simulation Workflows



Democratization

Structuring the principle of operation



Teamcenter (PDM)

+

optiSLang SPM



Teamcenter

- Datamanagement (CAx Data, Cax Prozesse, ...)

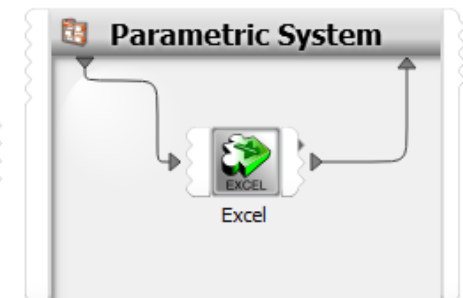
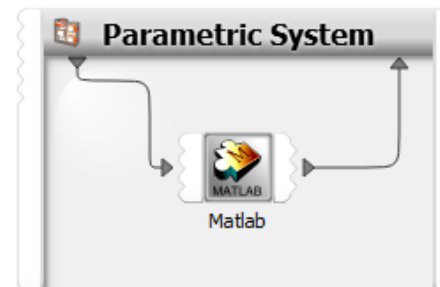
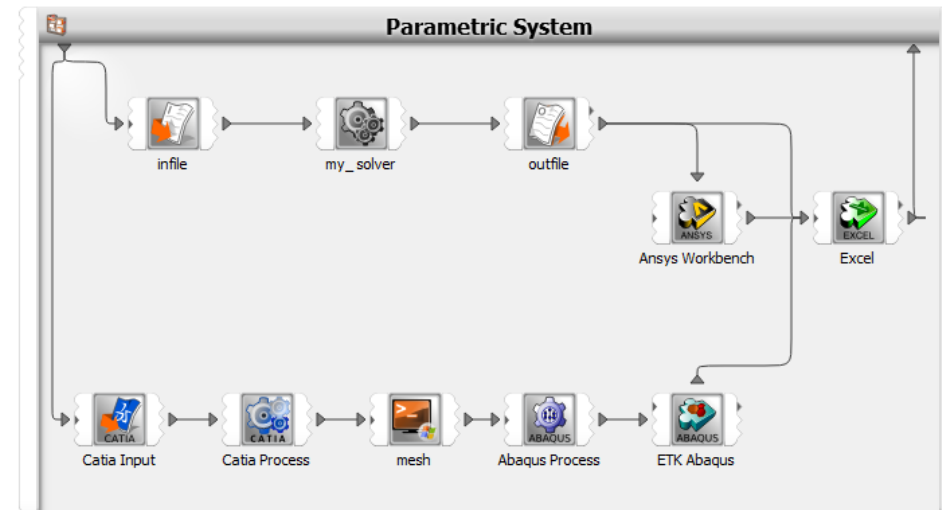
optiSLang:

- Automatize and Standardize CAx Processes

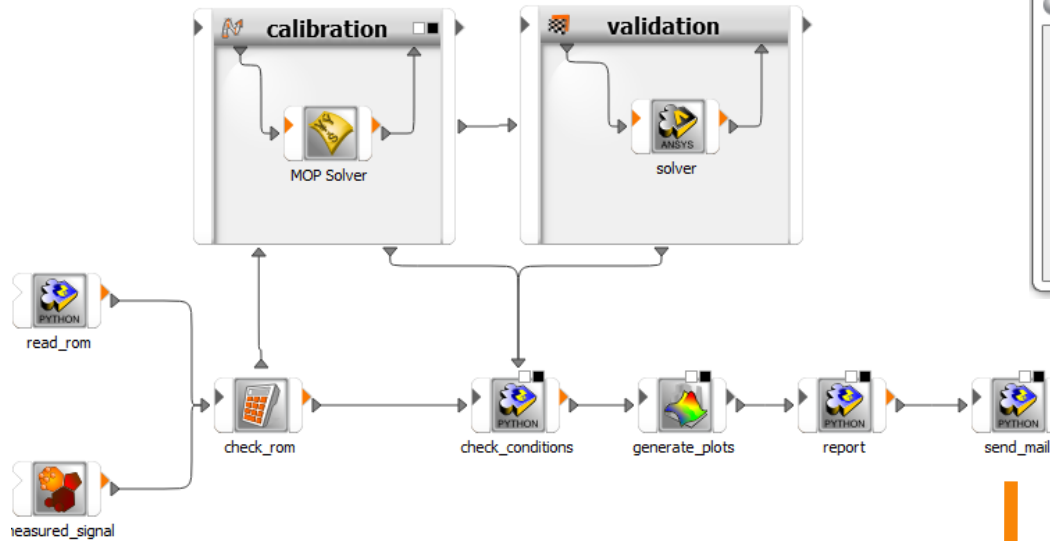
Simulation Engineer

Build CAE flow - Use optiSLang process integration

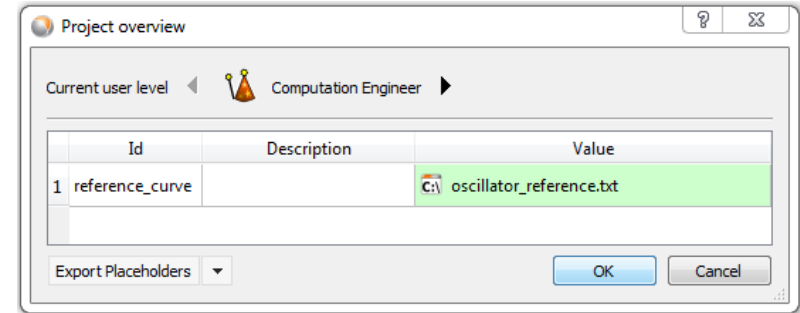
- Graphical setup
 - “Like a flowchart”
 - Wizard supported
- Combine
 - CAD Tools: CATIA, Creo, ...
 - Solver: ANSYS, Abaqus, LSDyna ...
 - Other: Excel, Matlab, ...
 - Internal solver
 - ...



Example: digital twin



Sensor data



publish workflow



Process Execution & Data Management

„In-field“ engineer uses published workflow

- Start EKM in web browser
- Connect measured curve to Identification flow
- Identified parameters within **seconds** using the data-based ROM
- Results are automatically stored

Calibrator Node

Measured Data

Select Calibrator Type

Define Analysis Name

Define Storage Location

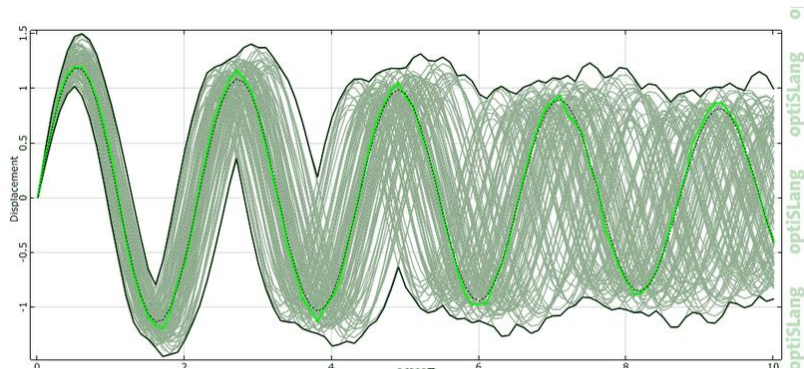
Machine 12345ab report
current state: measurement_0001.txt

Parameter	Value	Lower bound	Upper bound	
D	0.0150488305548	0.01	0.02	■ ■ ■
Dkm	17.6474019789	15.0	15.0	■ ■ ■
k	23.6562623875	20.0	30.0	■ ■ ■
m	2.84841062459	2.5	2.5	■ ■ ■

Digital twin results

- See results in EKM – report
- Archived for traceability

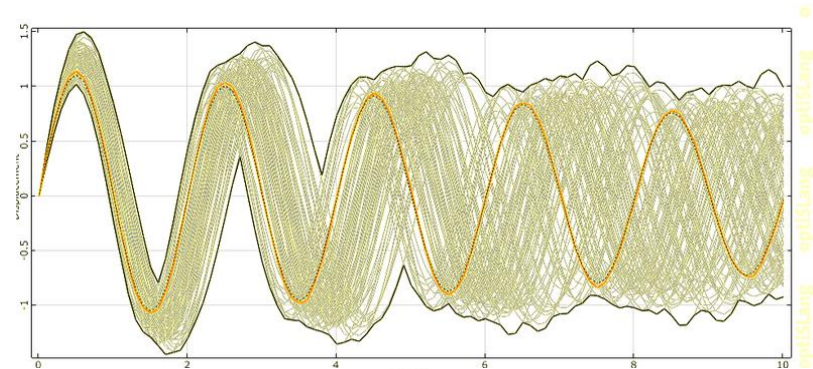
current state: measurement_0001.txt



Parameter	Value	Lower bound	Upper bound	
D	0.0151504200557	0.01	0.02	■ ■ ■
Ekin	17.2913530143	15.0	25.0	■ ■ ■ ■
k	26.5128429852	20.0	30.0	■ ■ ■ ■
m	2.75584511941	2.5	3.5	■ ■ ■ ■

- All machine parameter green
- No maintenance necessary

current state: measurement_0003.txt

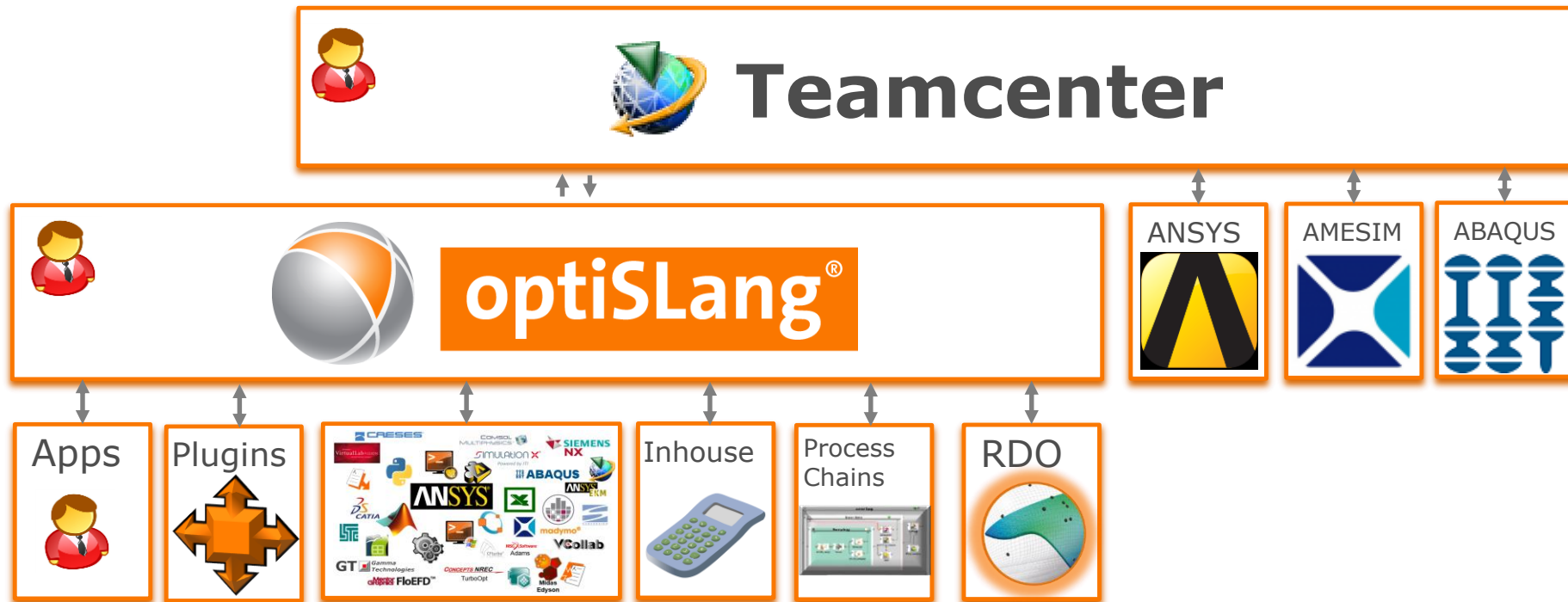


Parameter	Value	Lower bound	Upper bound	
D	0.0146748101639	0.01	0.02	■ ■ ■ ■
Ekin	17.206301795	15.0	25.0	■ ■ ■ ■
k	27.0066191966	20.0	30.0	■ ■ ■ ■
m	2.74260291873	2.5	3.5	■ ■ ■ ■

- Some machine parameter yellow
- maintenance needs to be scheduled

optiSLang & Teamcenter for Simulation

- Some Standard integrations
- optiSLang for complete CAx-World, workflows,...
- ➔ Most efficient Solution for customer (cost, flexibility, time, innovation,...)





ANSYS® EKM

Process Execution & Data Management



optiSLang EKM interfacing layer



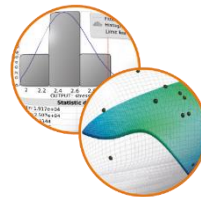
optiSLang Simulation Workflows



CAx Automation



Robust Design Optimization



Data Analysis & ROM

ANSYS Simulation Plattform



Fluids



Structures



Electronics



Semiconductors



Systems



Embedded Software



Multiphysics

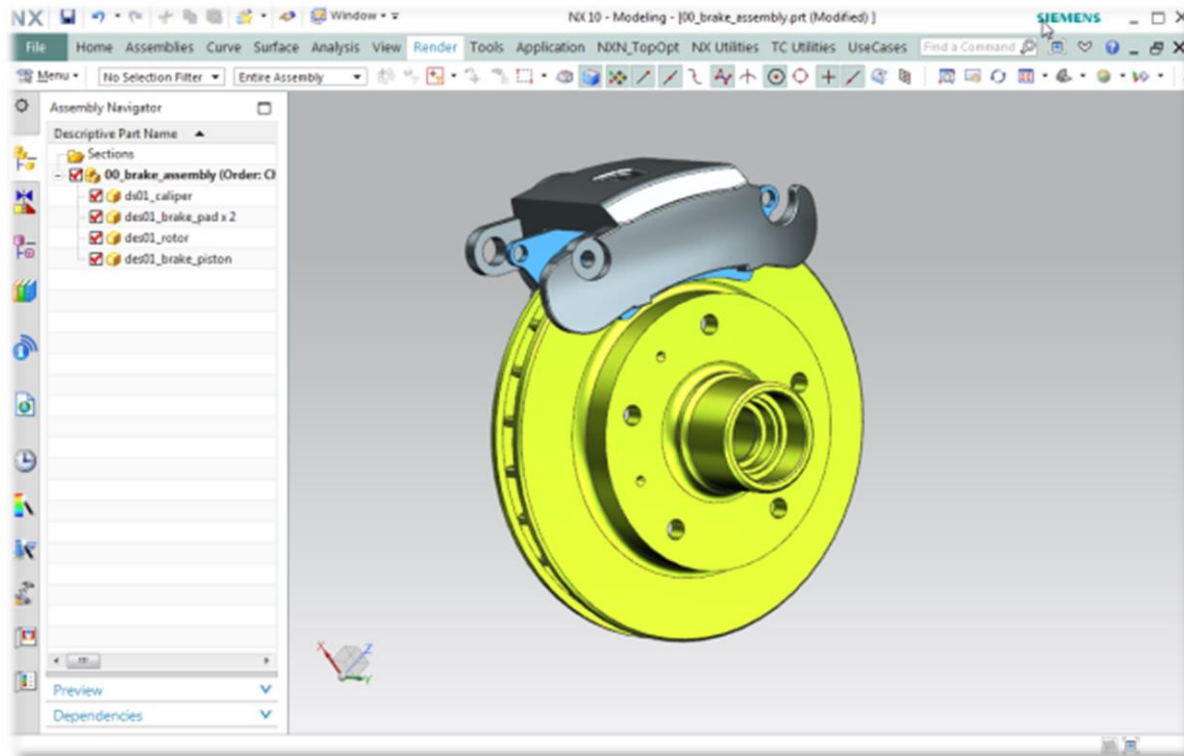


Platform

Collaborative Work



Brake



(1) Designer: NX – CAD Data – works as he is used to work...

(2) Stress analyst:

- Create simulate different loadcase
- Create flow for Dynamic analysis



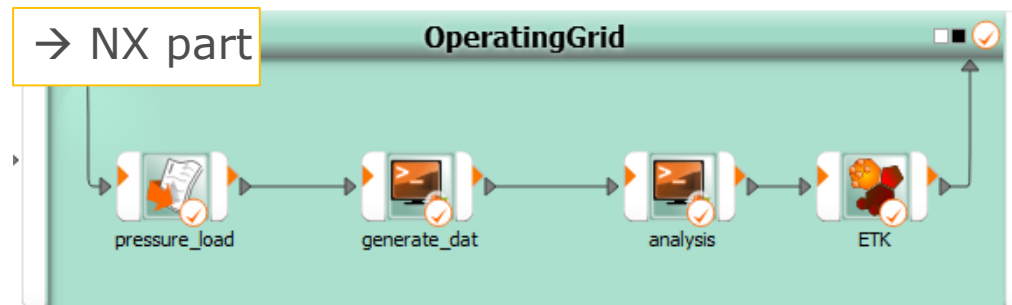
(3) Manager:

- Builds (or let built) a flow for cost calculus (*Input: NX part*)
- owns the Excel-sheet (confidential)

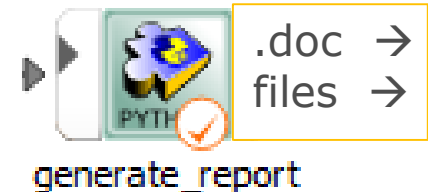


(4) CAx Workflow builder:

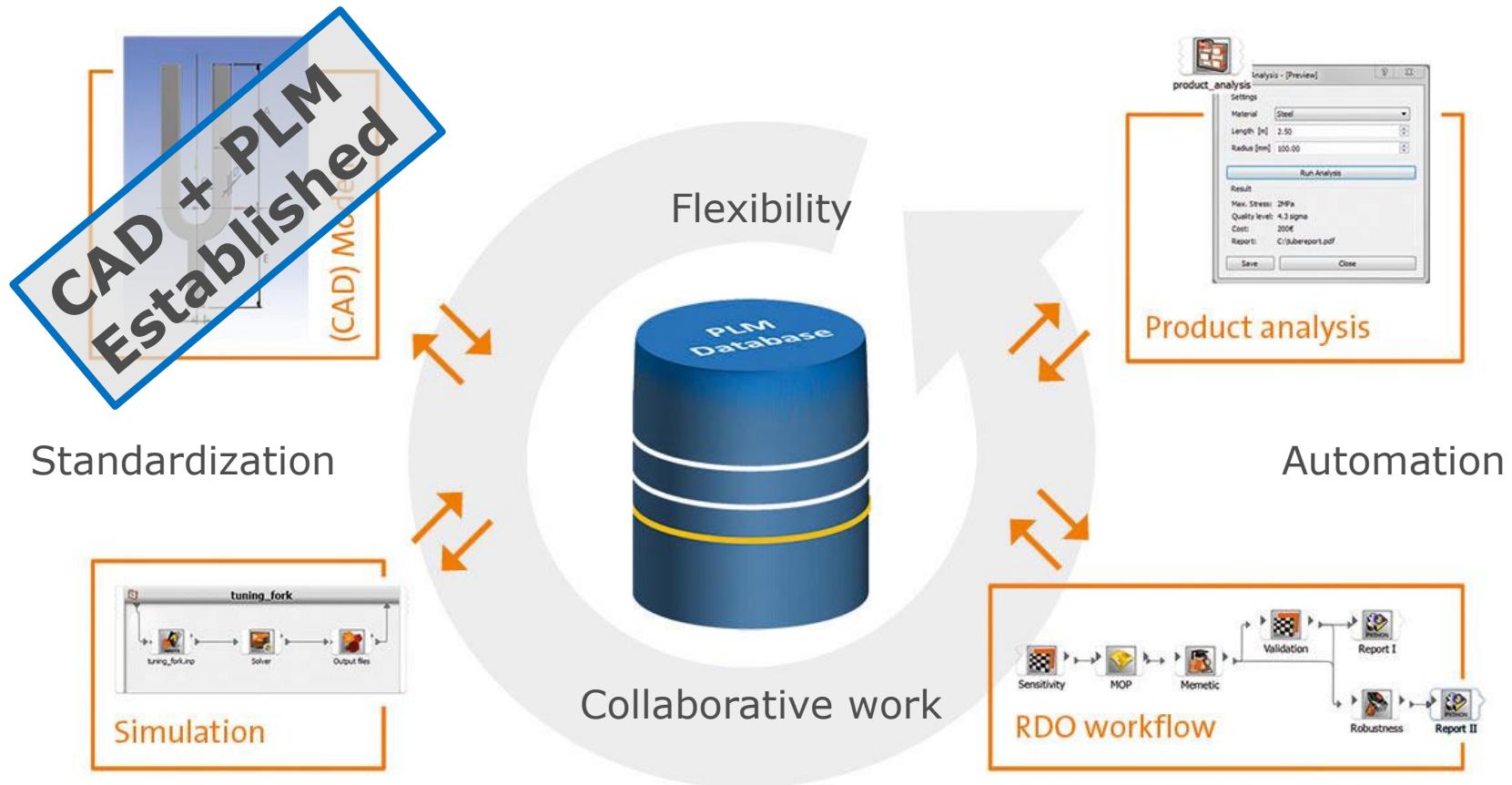
- Generate a report
- Connect everything
- Publish




(5) Analyst: someone of the above mentioned or anyone else



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





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