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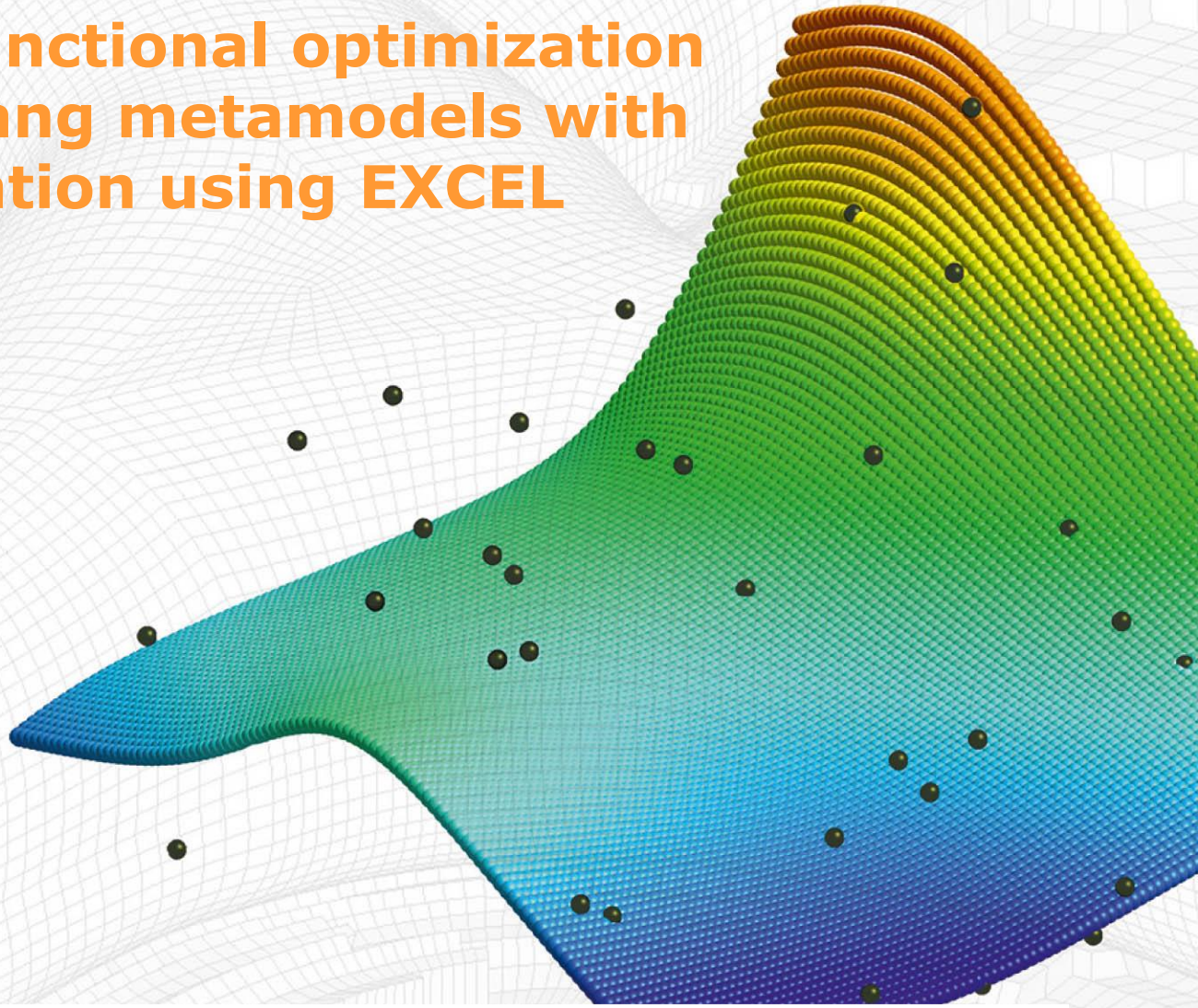
Combining functional optimization using optiSLang metamodels with cost optimization using EXCEL



Dr.-Ing. Johannes Will
Dynardo GmbH

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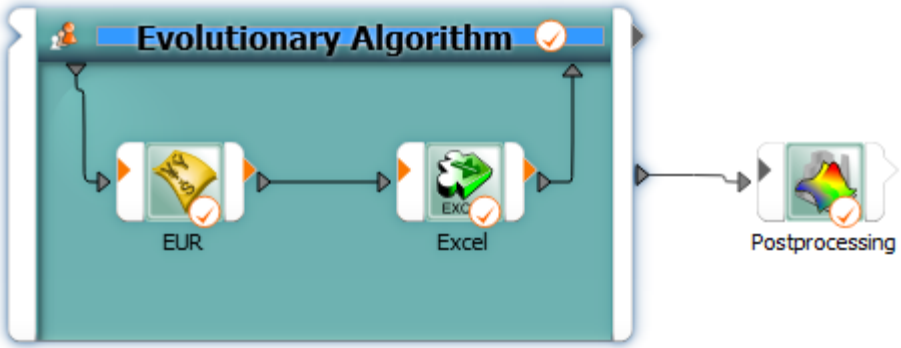
Link functional optimization metamodels with EXCEL cost sheets in optiSLang

- optiSLang is used to build the workflow
- optiSLang metamodels are used to approximate product performance
- Excel is used to host the cost structure
- metamodels are connected to Excel to support cost model (which is related to design variants)
- Product performance related to product cost can be optimized
- Because of conflicting nature of cost and performance their is no single optima



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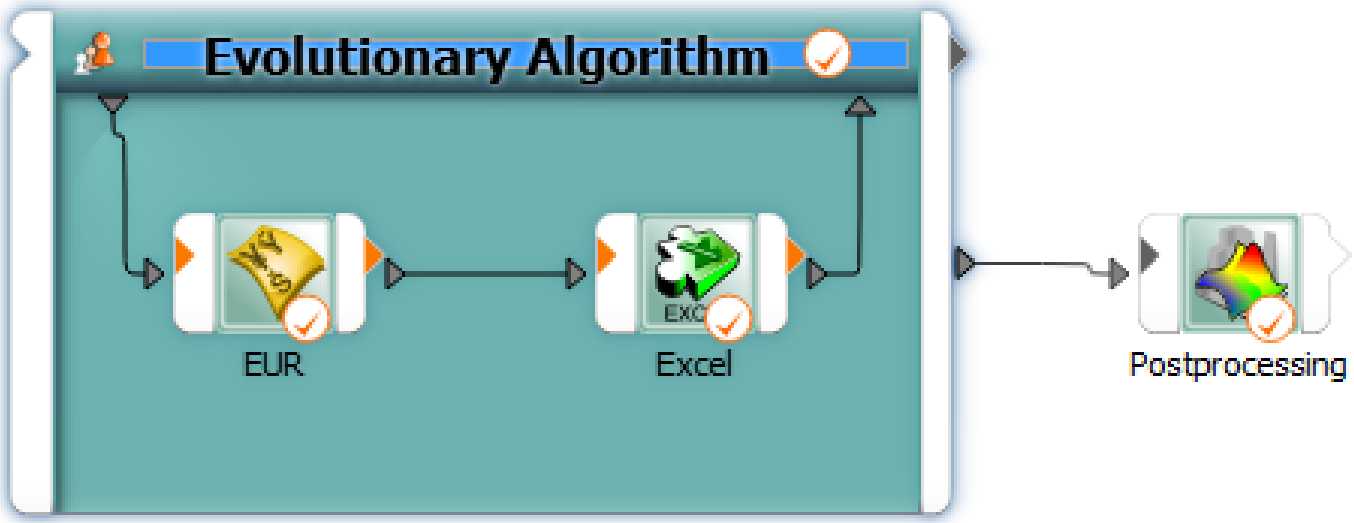
Step by Step connect MOP and EXCL



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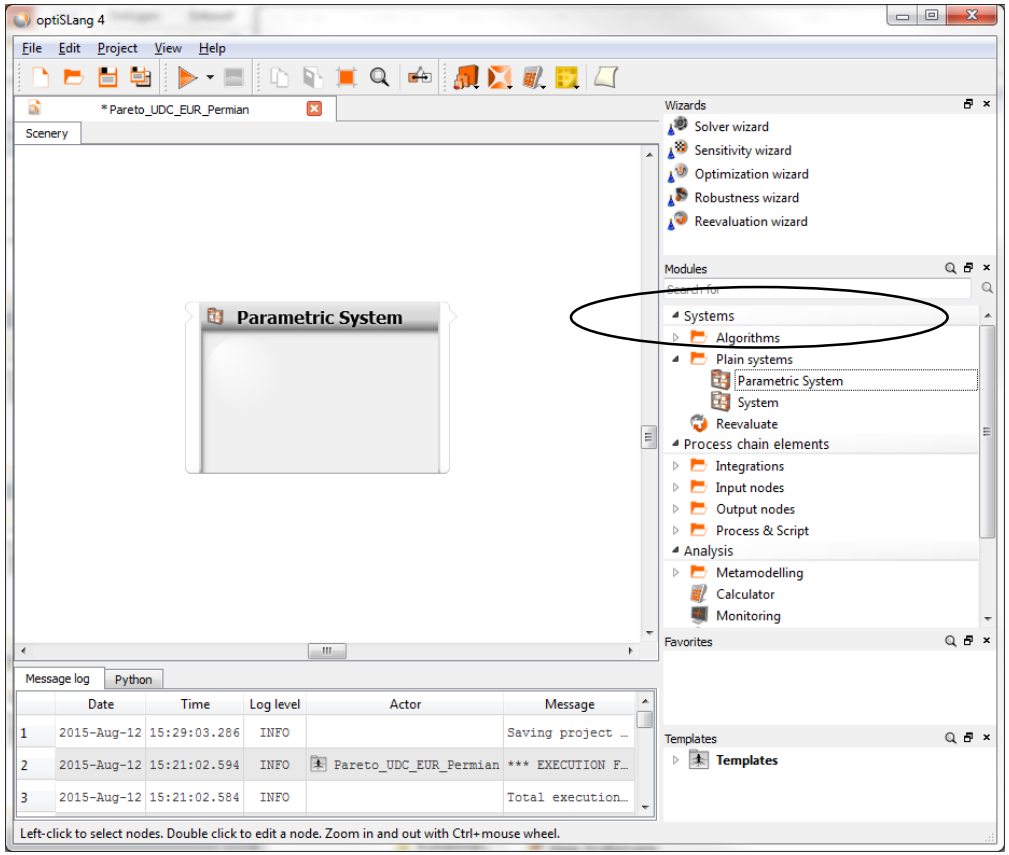
Generate the optiSLang project for Optimization using one MOP's for AHCIIP and EXCEL for production and costs

1. Generate the parametric system

- Type "Param" under "Modules" to search for module parametric system
- Drop a parametric system to the scenery



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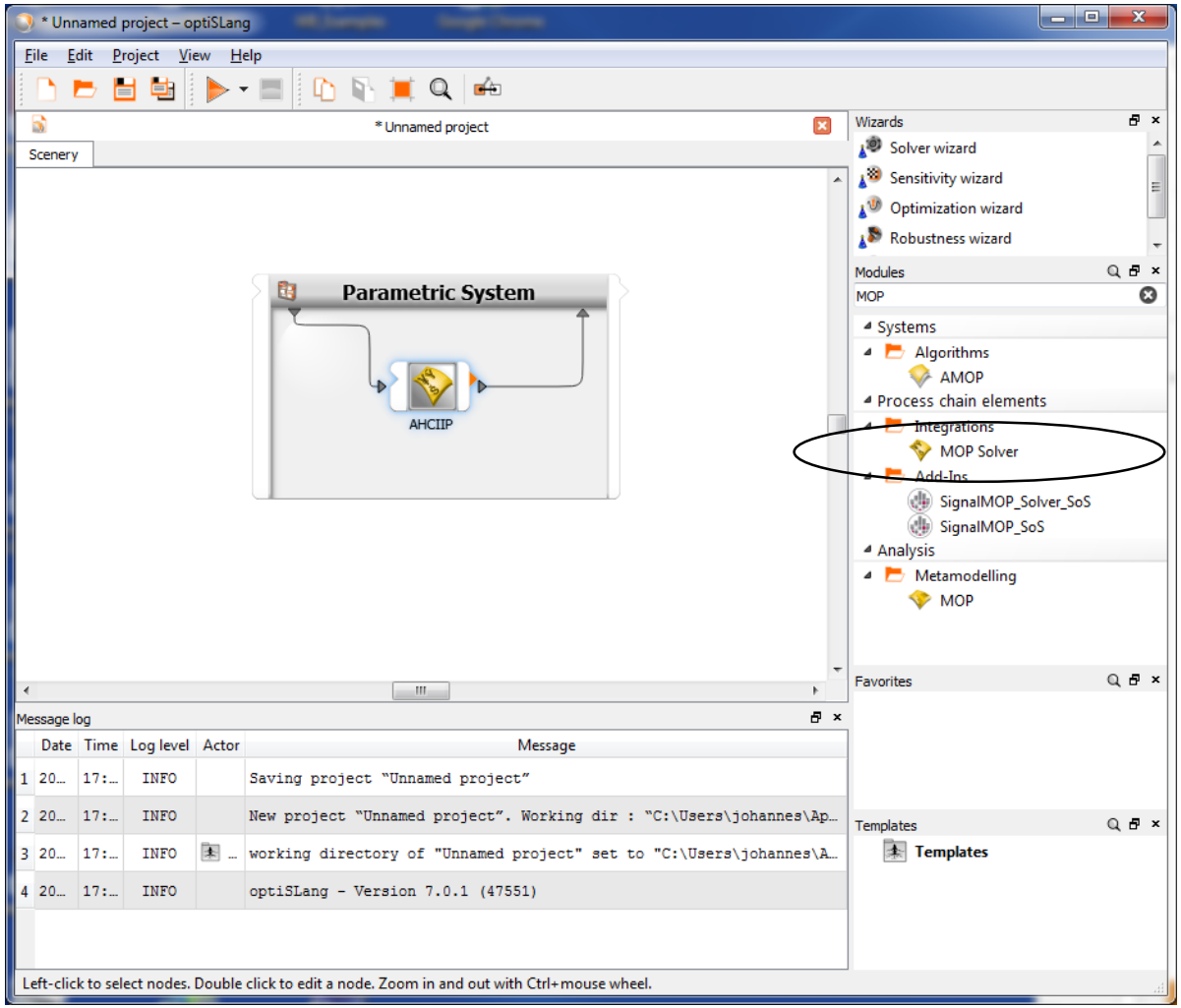
2. Introduce an MOP-solver node

- Type MOP under “Modules”
- Drop **one** Integration node “**MOP solver**” into the parametric system
- Name the MOP’s to “AHCIIP”



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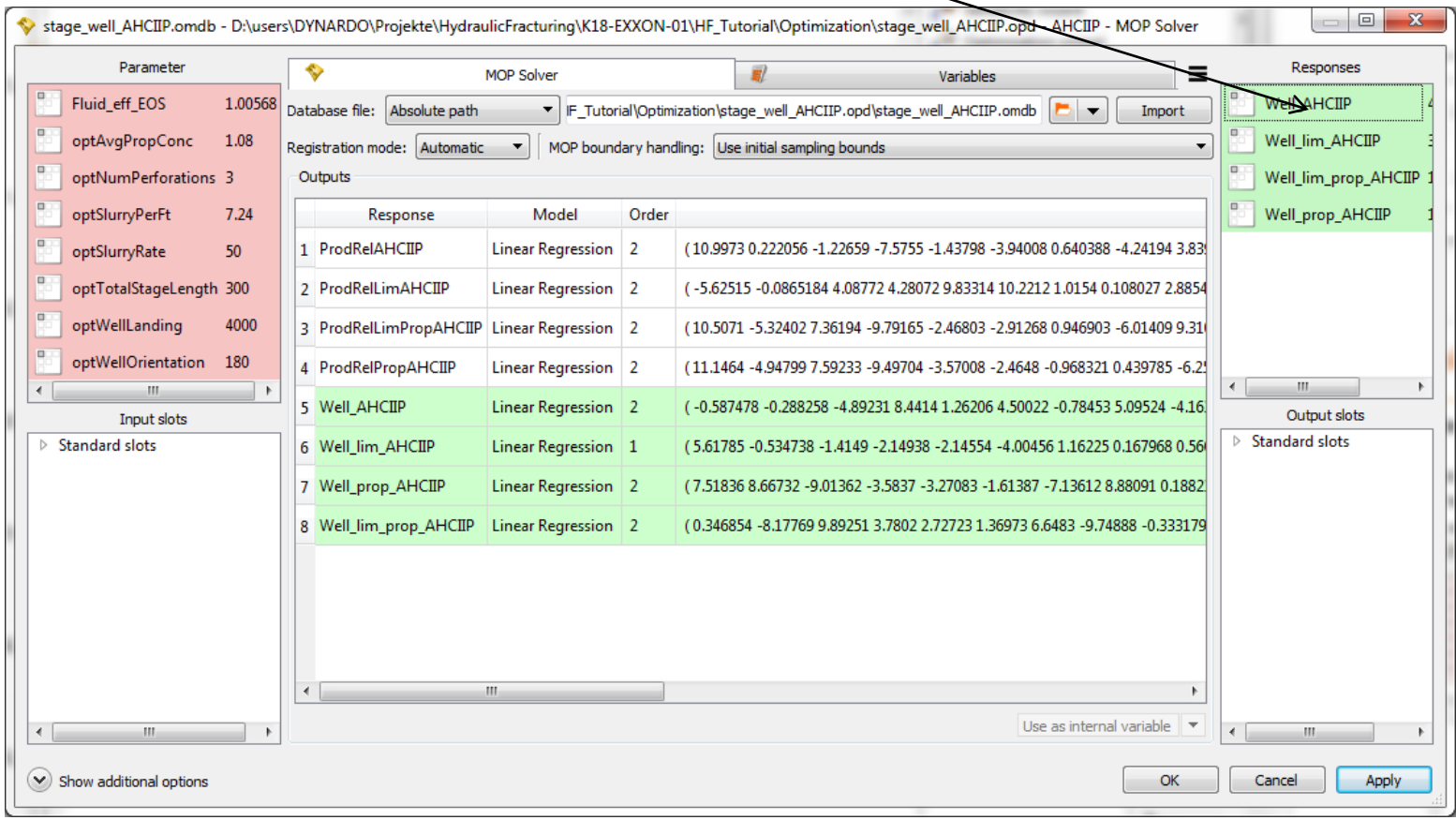
3. Define Response Parameter from MOP

- Double click on MOP “AHCIIP”
- Import MOP file “stage_well_AHCIIP.omdb” in directory home*.opd
- Define and check Responses in the Response window



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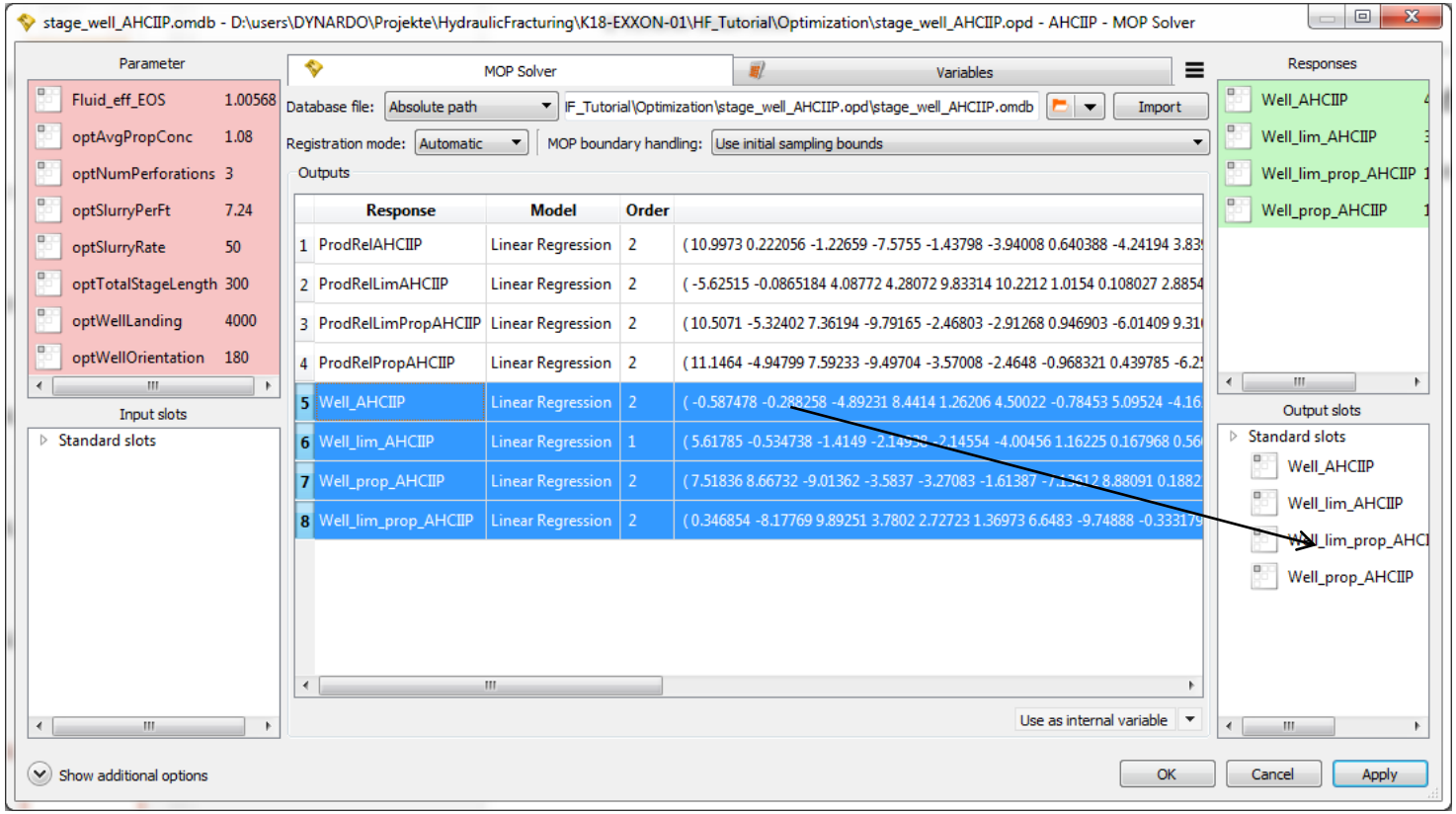
4. Define floating variables (for EXCEL) via "output slot" from AHCIIP

- Note: In addition we need AHCIIP estimates in Excel. That is possible by defining them as "Output slots"
- Drag into Output slots
- Press "OK" to close the Dialog



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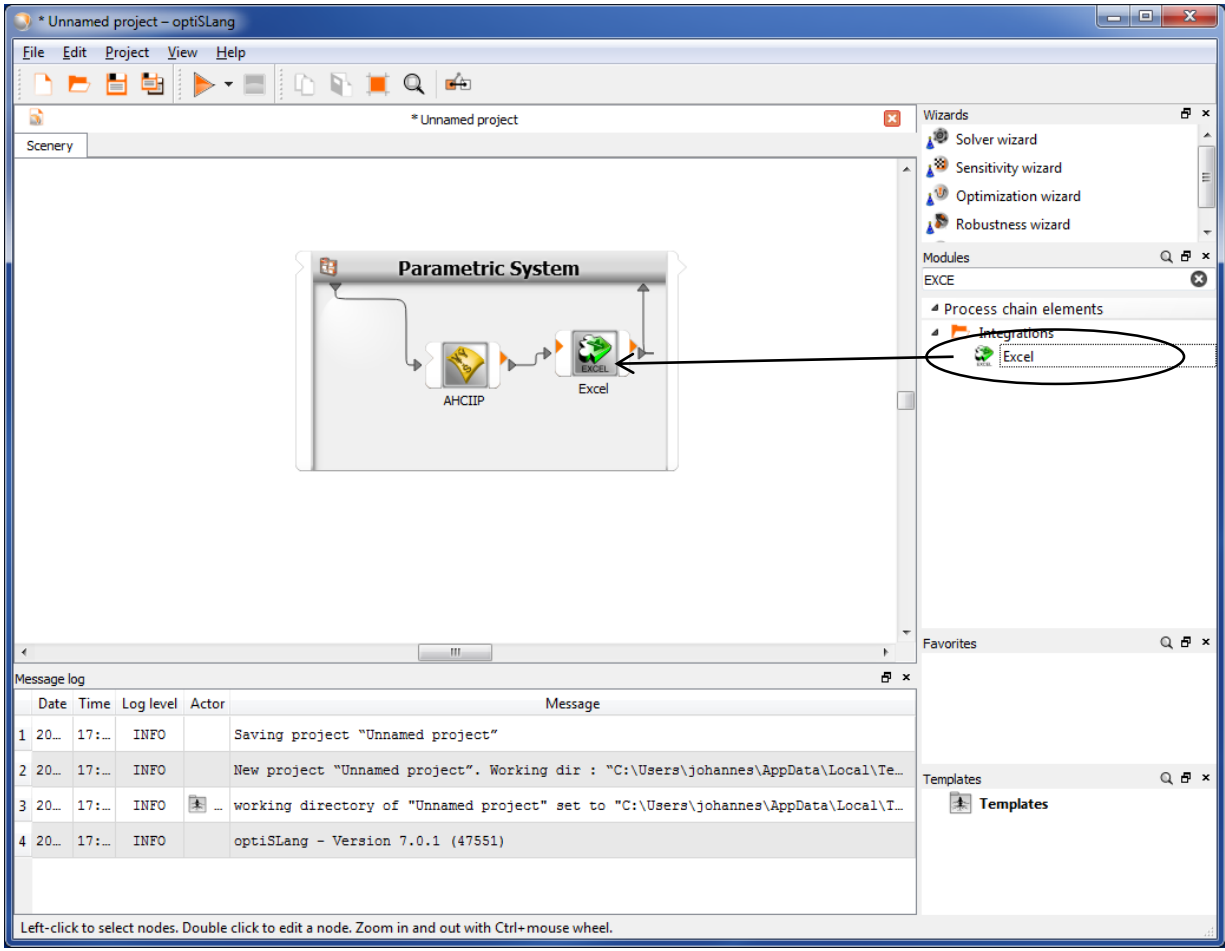
5. Introduce an EXCEL-solver node

- Type EXCEL under "Modules"
- Drop an EXCEL Integration node on the connection line between MOP solver and Parametric system



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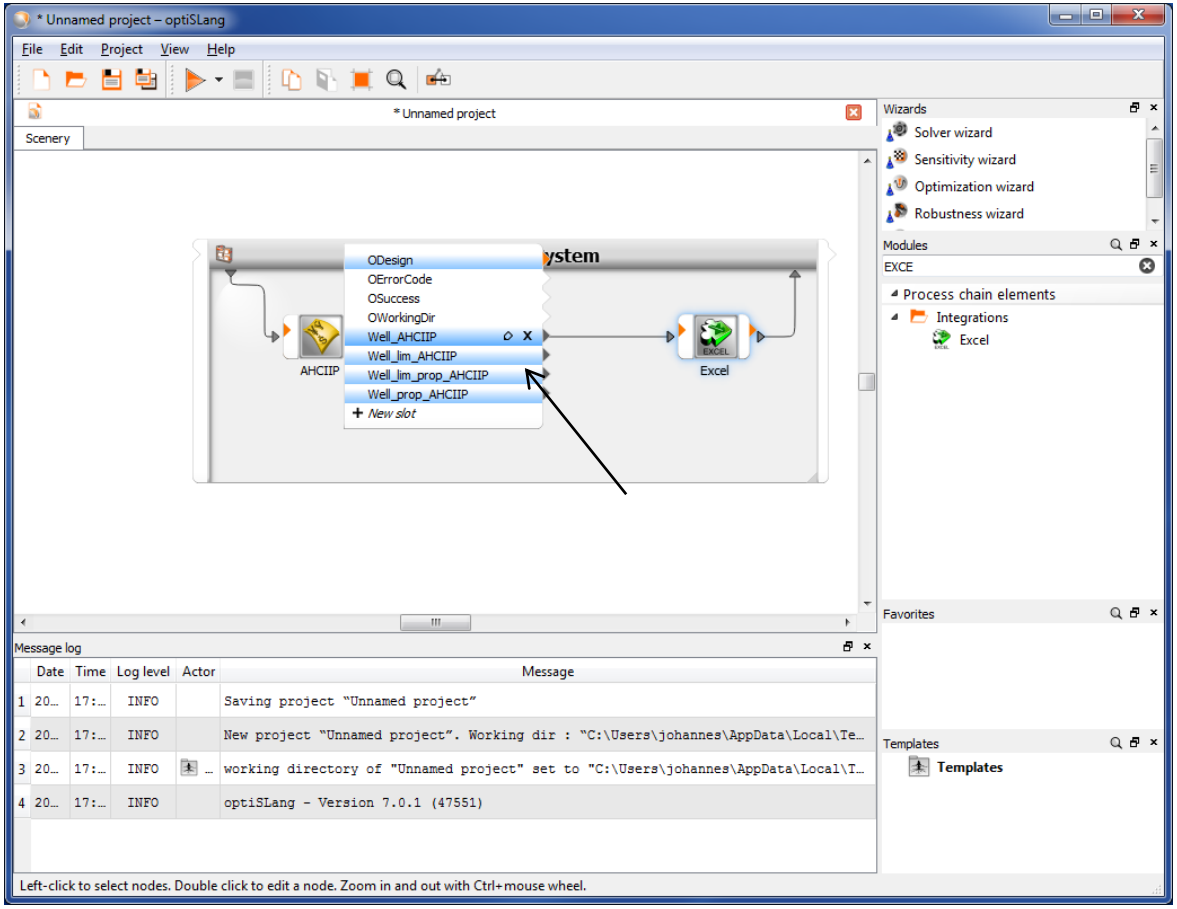
6. Define variable flow from MOP to Excel

Define which variables are transferred between MOP and EXCEL

- Go with the cursor to the output slot of the MOP solver (orange triangle), select via mouse the slot



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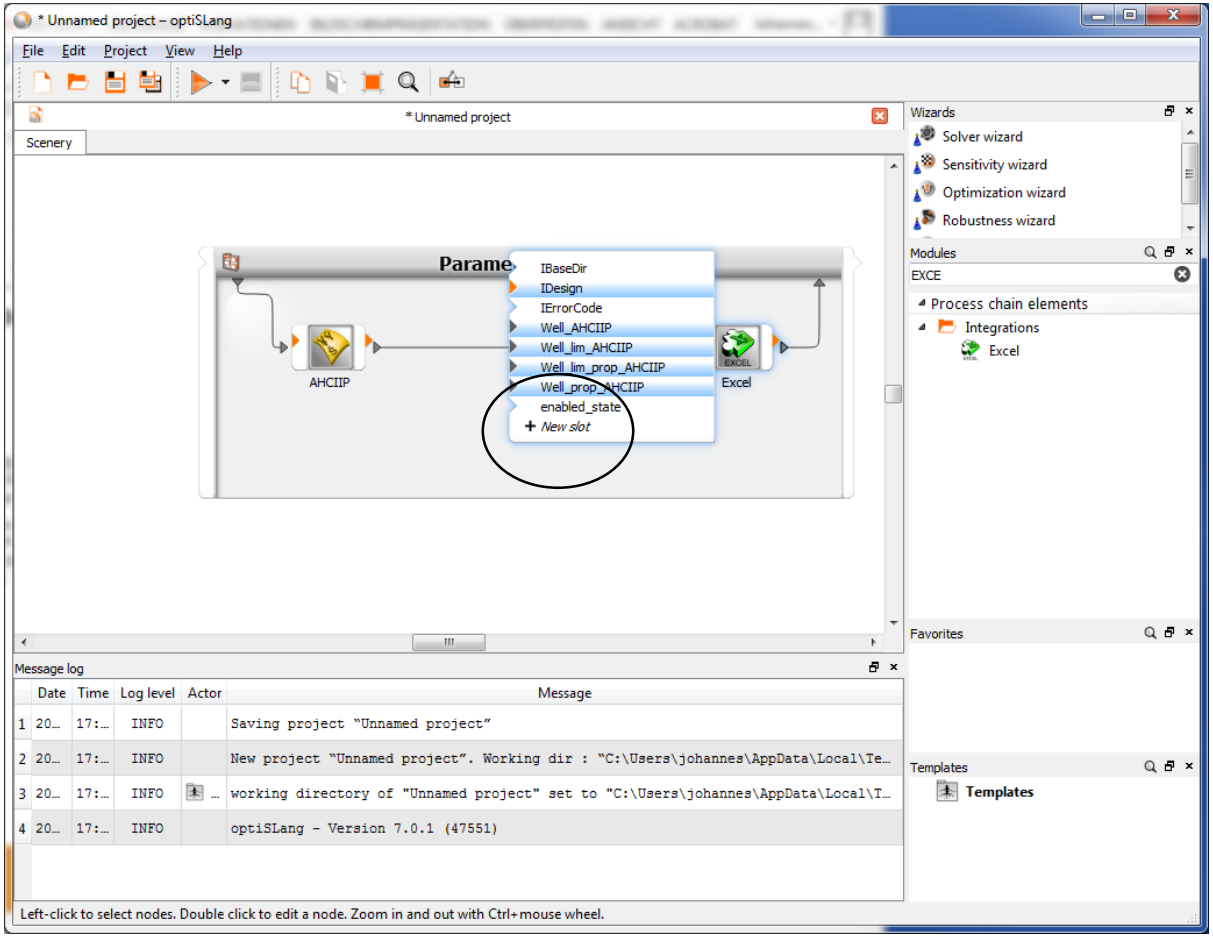
6. Define variable flow from MOP to Excel

- Drag slot variables to the input slot of EXCEL (orange triangle) and drop on "+New slot"
- than the selected output slot of MOP is defined to be an input slot of EXCEL and appears as new input slot



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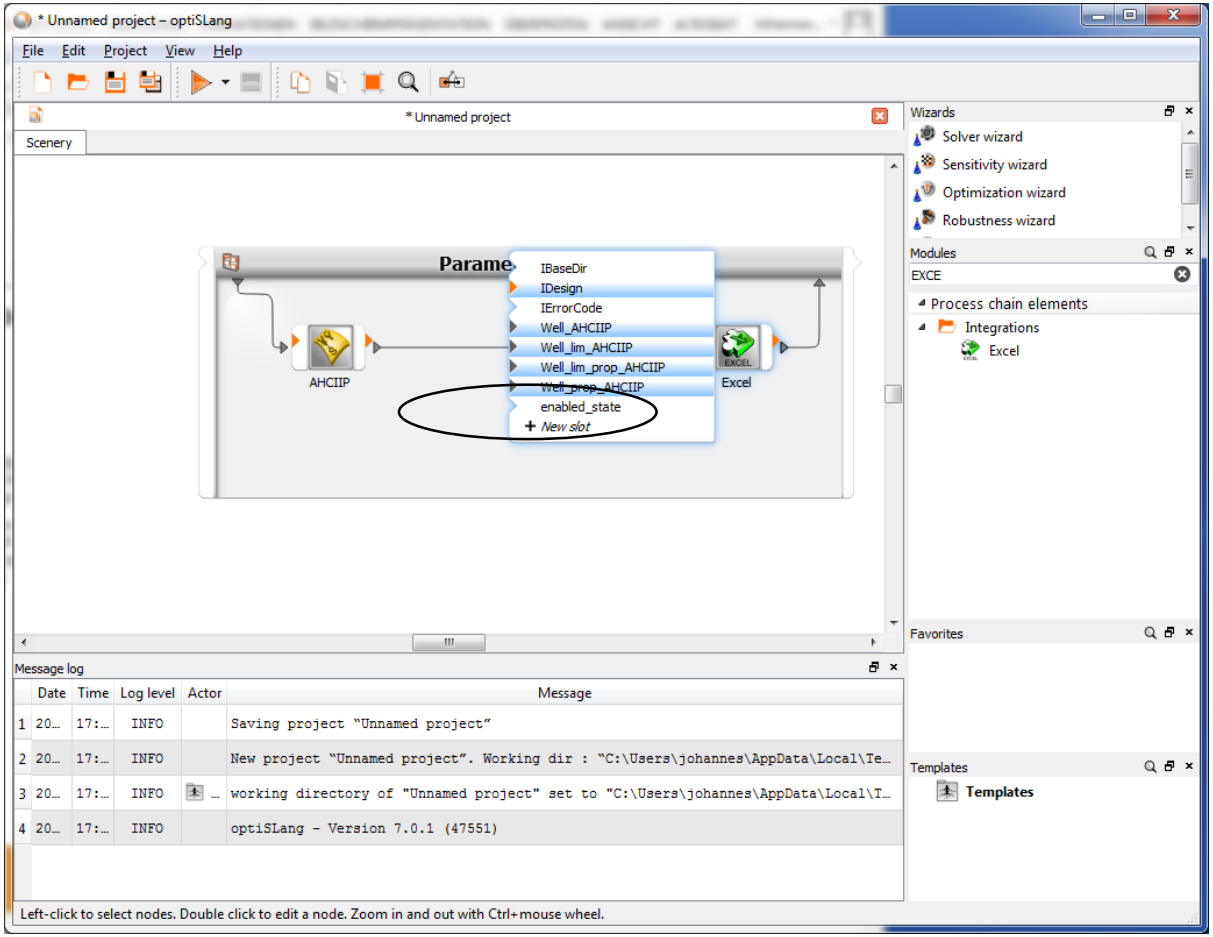
6. Define variable flow from MOP to Excel

- Repeat to define other responses as input slot of the Excel node

Than the defined responses from the MOP are transferred to EXCEL node



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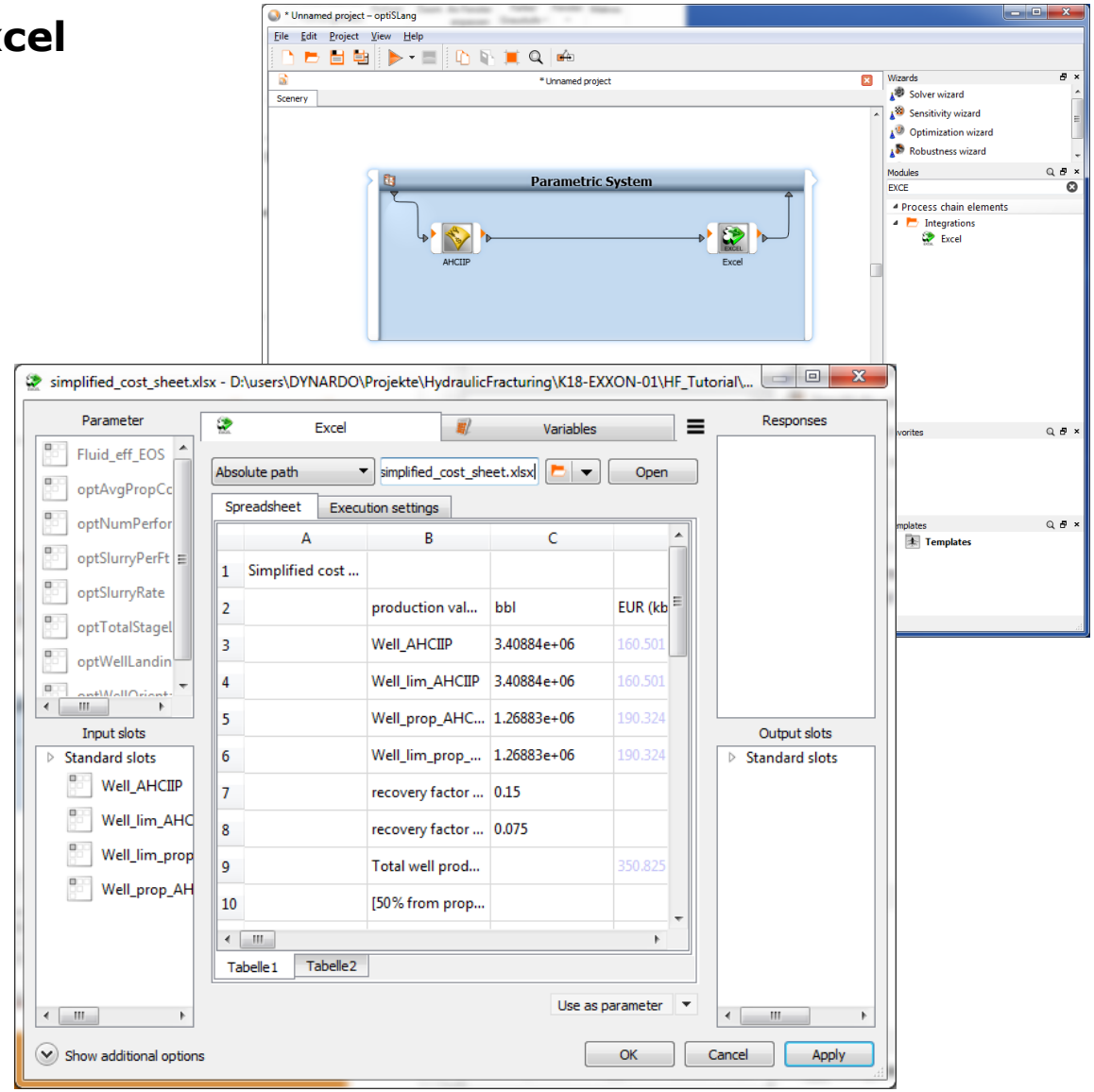
7. Define variable flow in Excel

- Double click on EXCEL node
- Import Excel file "Simplified_cost_sheet.xls" in directory home*.opd

Note:

- MOP input parameter are known from Parametric system, but needs to be connected to Excel cell
- MOP response parameter are available as "Input slots" and need to be connected to Excel cells



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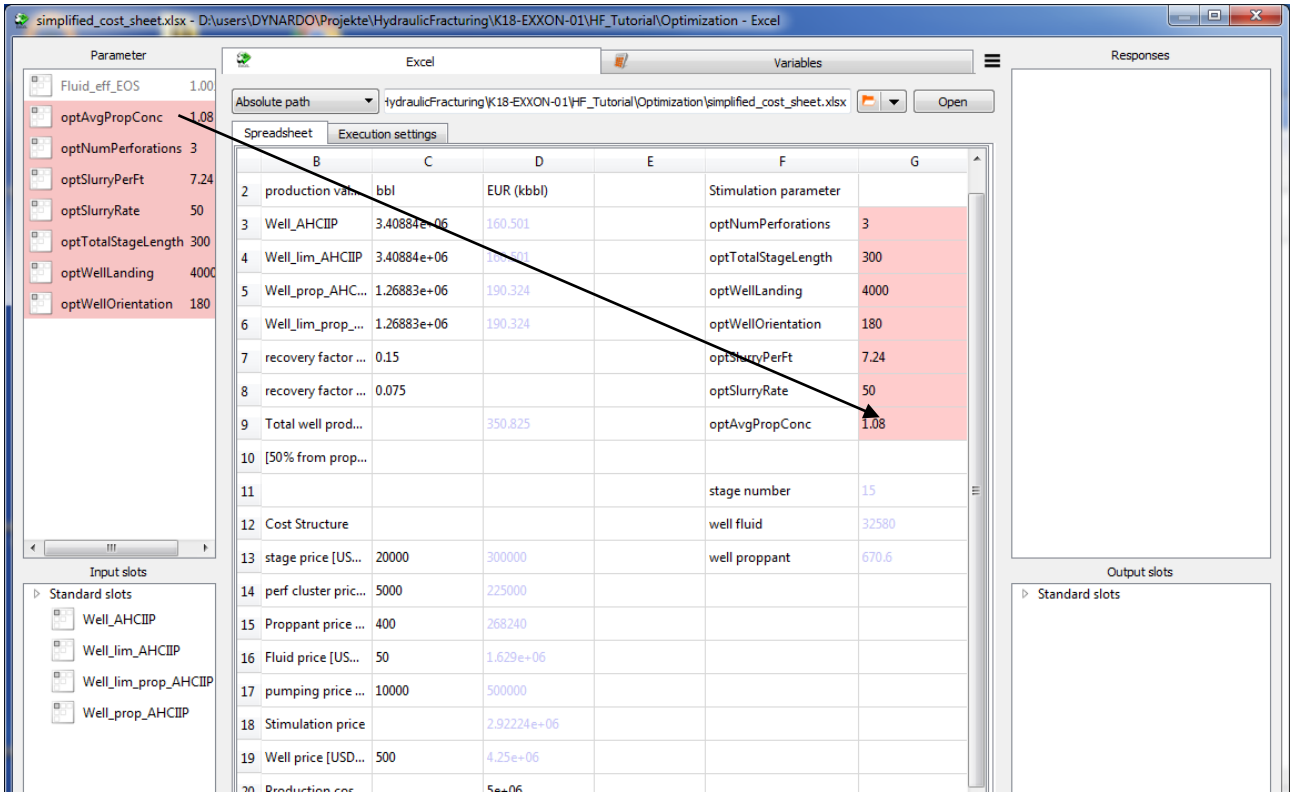
7. Define variable flow in Excel

- Connect Parameter

Note:

- Define the EXCEL cell for optAvgPropConc value placement by dragging Parameter "optAvgPropConc" to the cell
- Repeat for all operational parameter used in Excel



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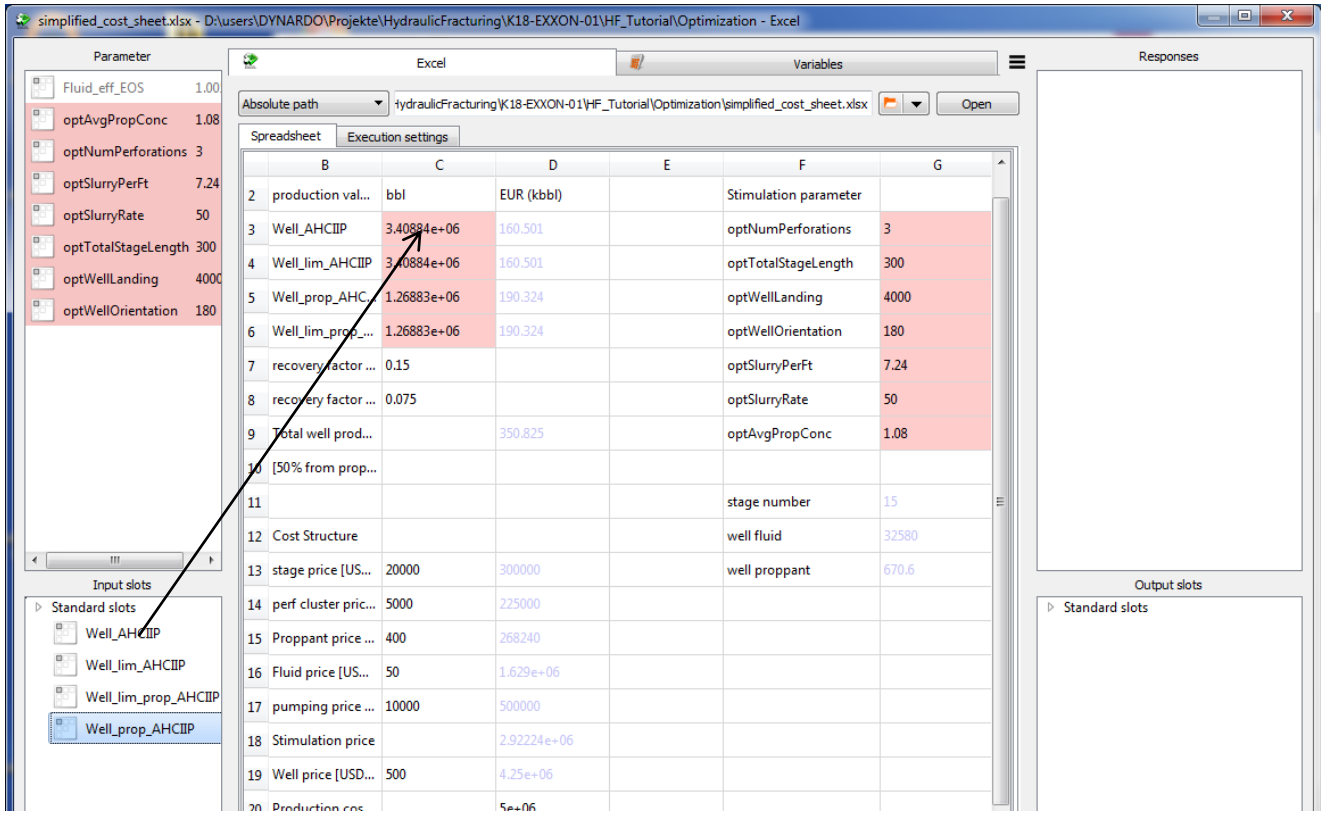
7. Define variable flow in Excel

- Connect Input Slots

- Define the EXCEL cell for "Well_AHCIIP" value by dragging Parameter to the cell

- Repeat for other three input slots



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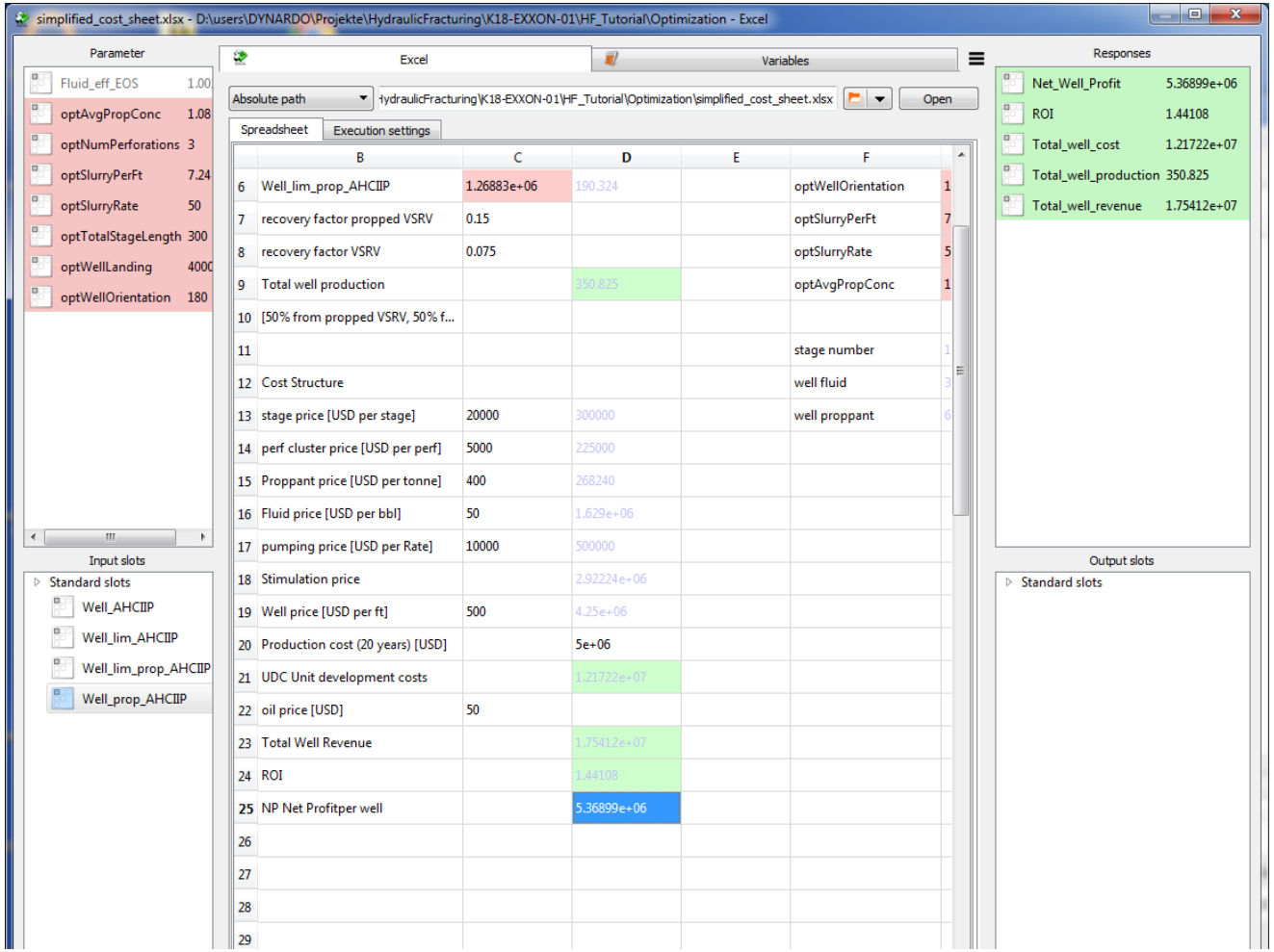
7. Define variable flow in Excel

- Introduce EXCEL Result values as Responses

- Define Response "Total_well_production " by dragging the value from EXCEL cell to Responses

- Repeat for other Excel Responses



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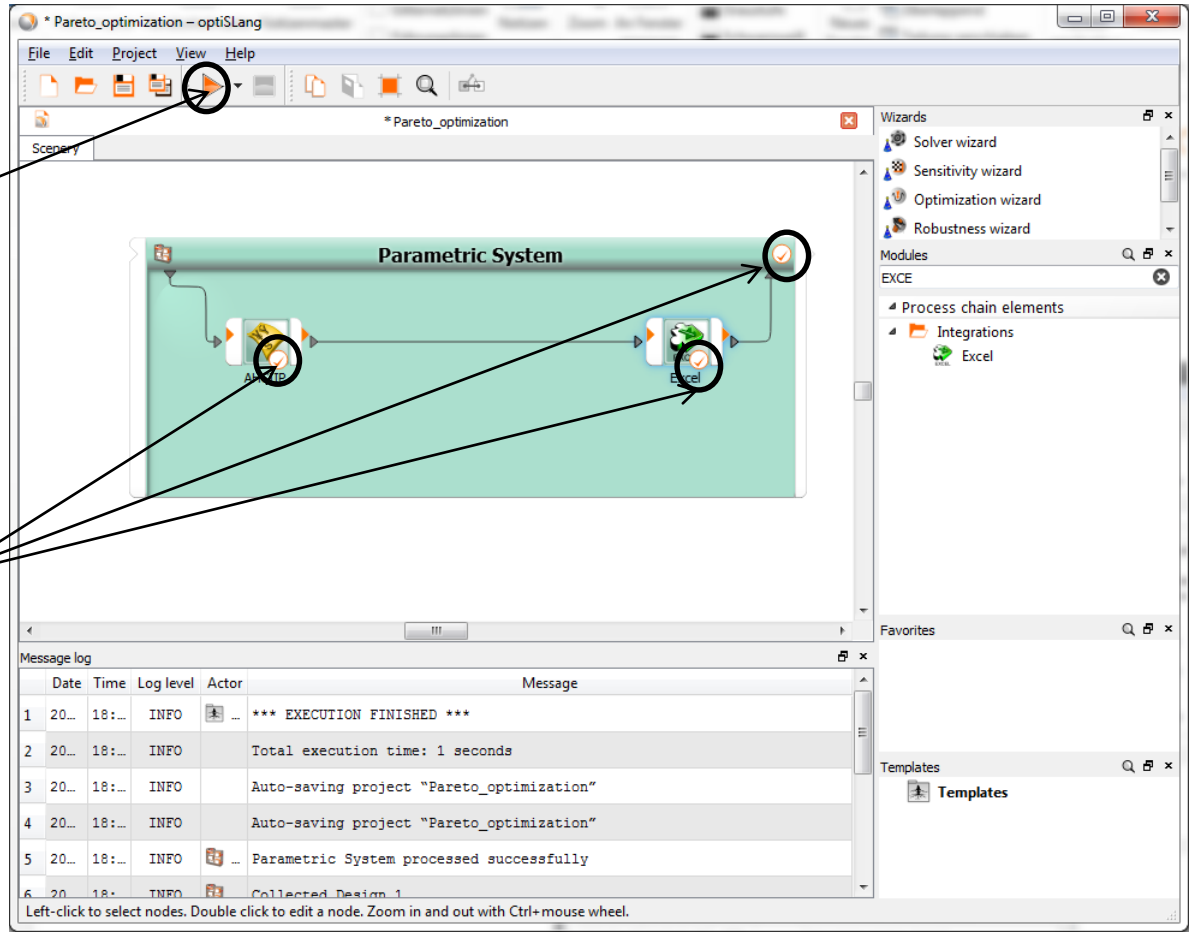
8. Check variable flow in Parametric System

- Close the Excel node dialog “OK”
- Click on “Parametric system”
- If not done before you are asked to save the project
- Click on run to check all connections
- Multiple show that all connections are working



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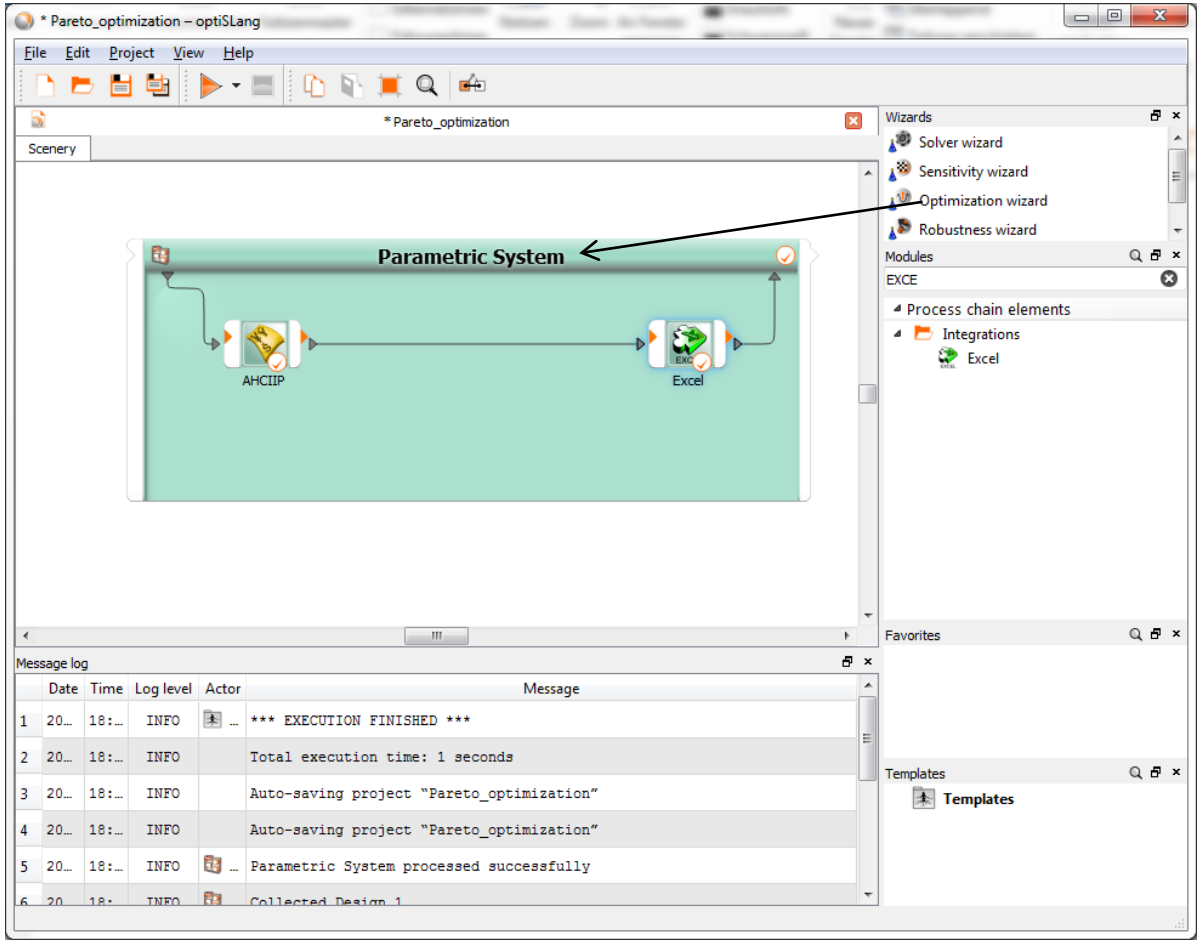
9. Apply Optimization

- To morph the Parametric system into an optimization module drag the optimization wizzard on the Parametric system



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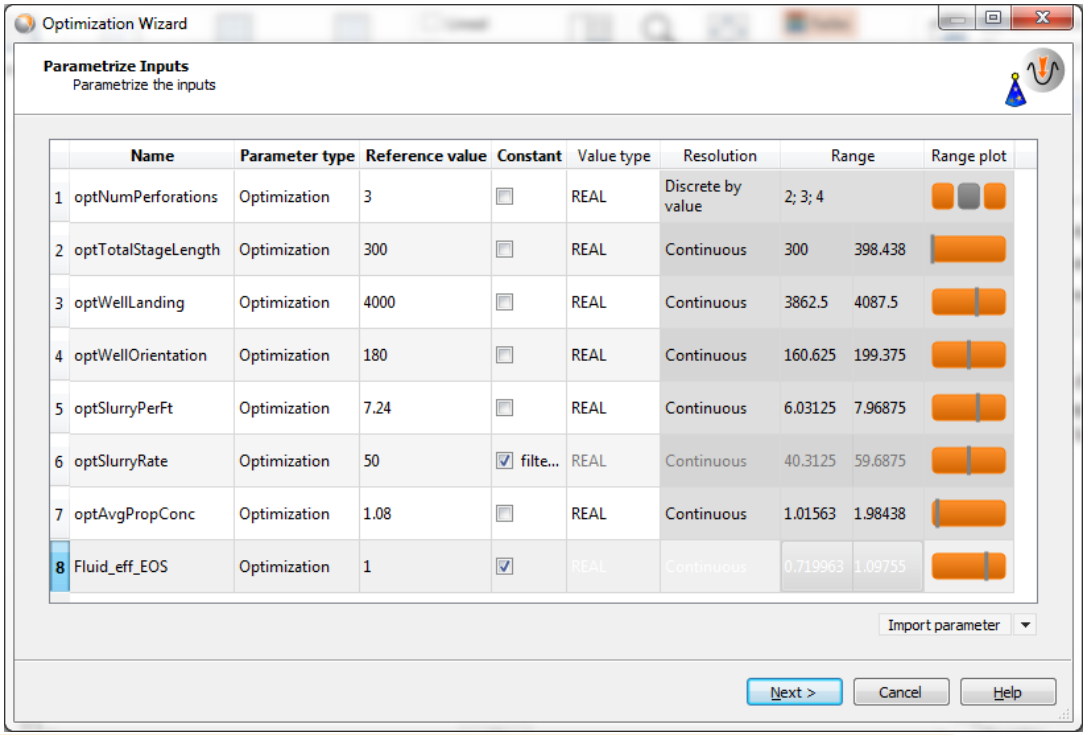
10. Define optimization parameter space

- Note that the range was taken from the MOP system
- Note that Slurryrate are filtered (because of low impact to responses)
- Change “optNumPerforations” to “dicrete by number” and define the range to 2,3,4
- Set Fluid_eff_EOS constant to 1.00



	Name	Parameter type	Reference value	Constant	Value type	Resolution	Range		Range plot
1	optNumPerforations	Optimization	3	☐	REAL	Discrete by value	2; 3; 4		
2	optTotalStageLength	Optimization	300	☐	REAL	Continuous	300	398.438	
3	optWellLanding	Optimization	4000	☐	REAL	Continuous	3862.5	4087.5	
4	optWellOrientation	Optimization	180	☐	REAL	Continuous	160.625	199.375	
5	optSlurryPerFt	Optimization	7.24	☐	REAL	Continuous	6.03125	7.96875	
6	optSlurryRate	Optimization	50	☑ filte...	REAL	Continuous	40.3125	59.6875	
7	optAvgPropConc	Optimization	1.08	☐	REAL	Continuous	1.01563	1.98438	
8	Fluid_eff_EOS	Optimization	1	☑	REAL	Continuous	0.719963	1.09755	

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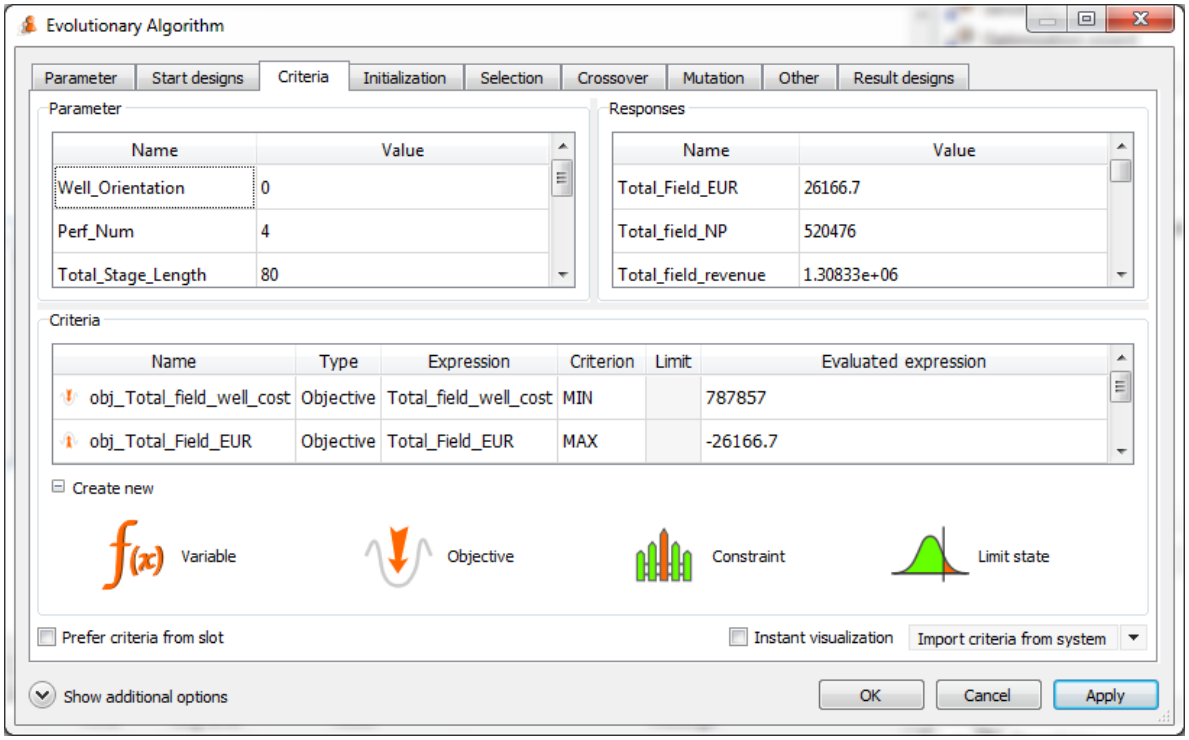
11. Define objectives

- Drag Total_Field_EUR to be the objective to be "Maximized"

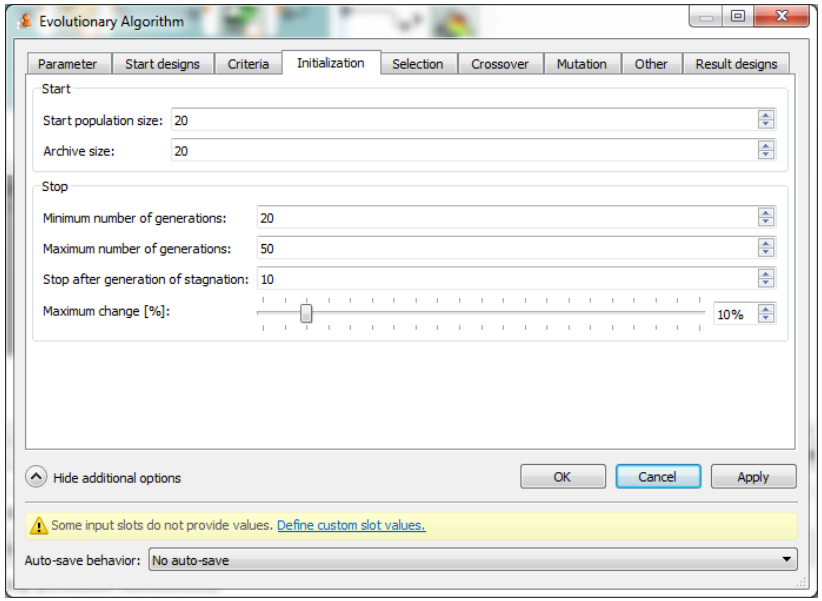
- Drag Total_field_well_cost to be the objective to be "Minimized"

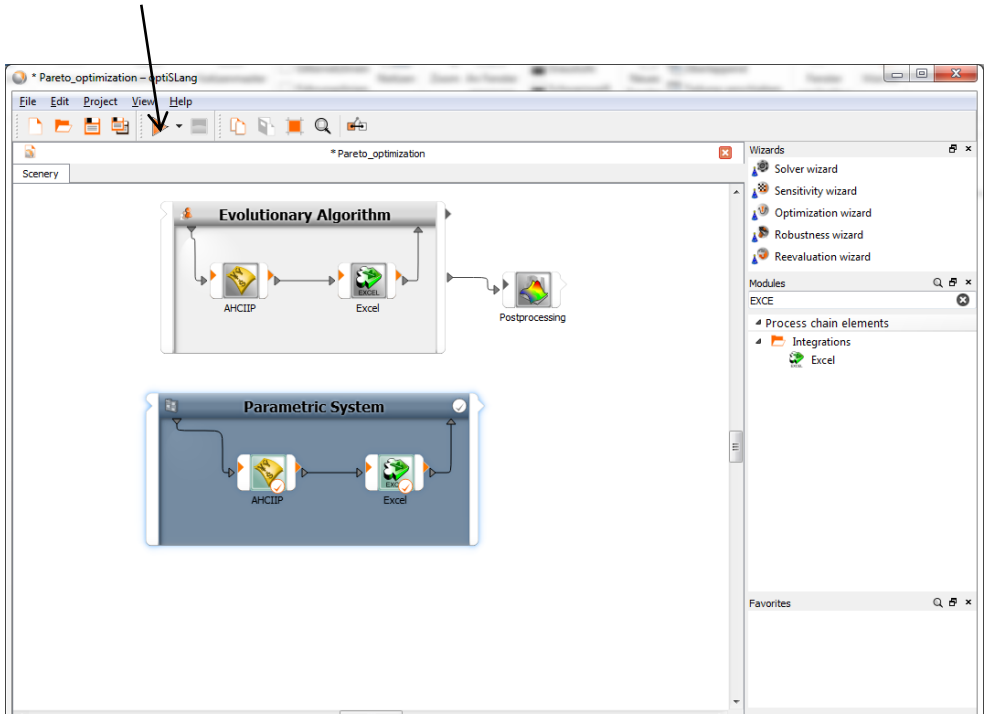


12. Finish the wizzard

- After finishing the optimization wizzard the “Parametric System” morph into “Evolutionary Algorithm”
- Define number of Start Population, Archive Size, minimum/maximum number of generation
- “no auto save”

13. Run optimizer





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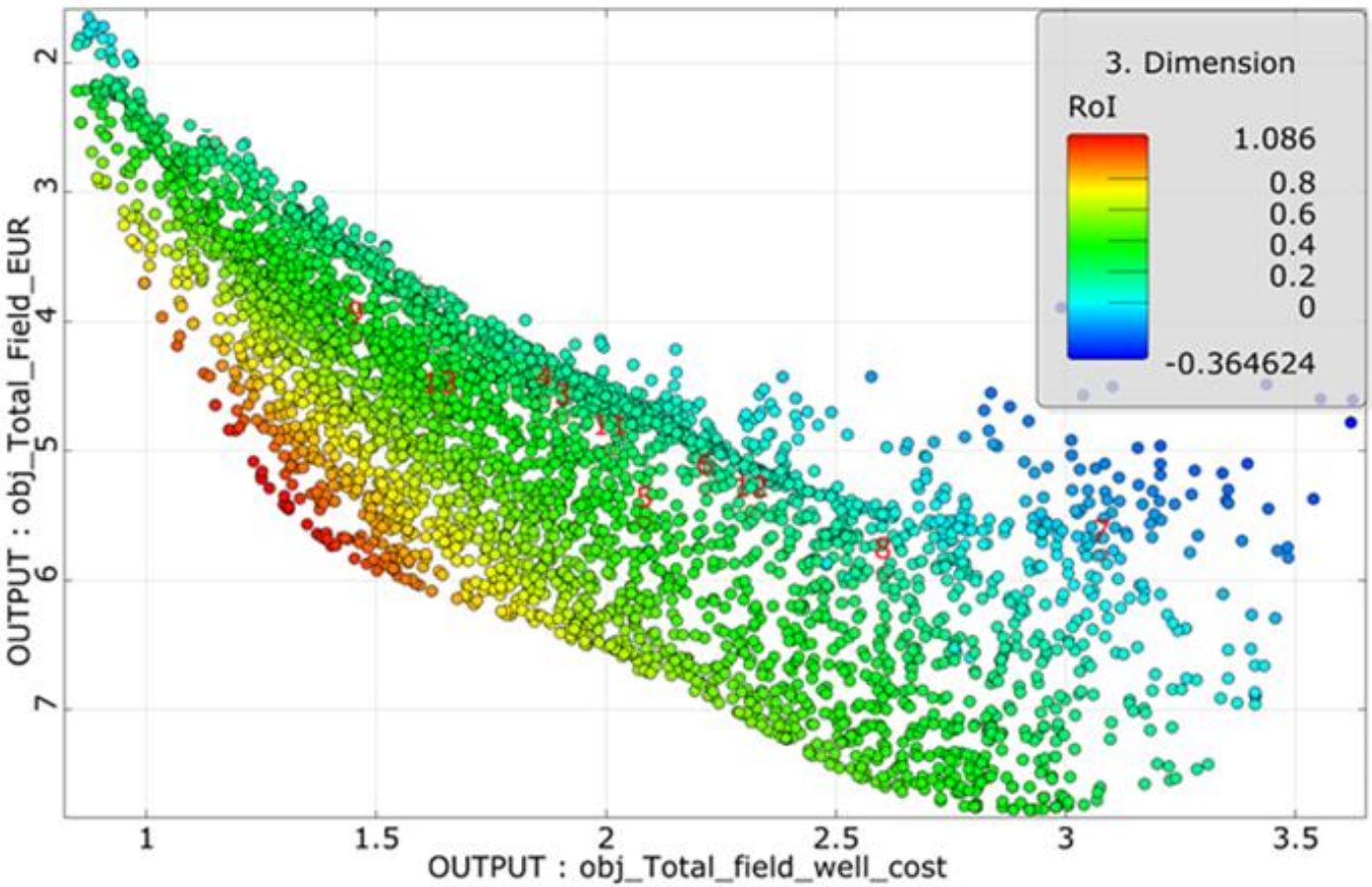
Oil and Gas Industry: Pareto chart to optimize field production with minimal field development costs

Based on best possible metamodels how variation of **operational parameter affect production** and best possible cost models the Pareto Frontier can be calculated.