iSIGHT-FD Overview

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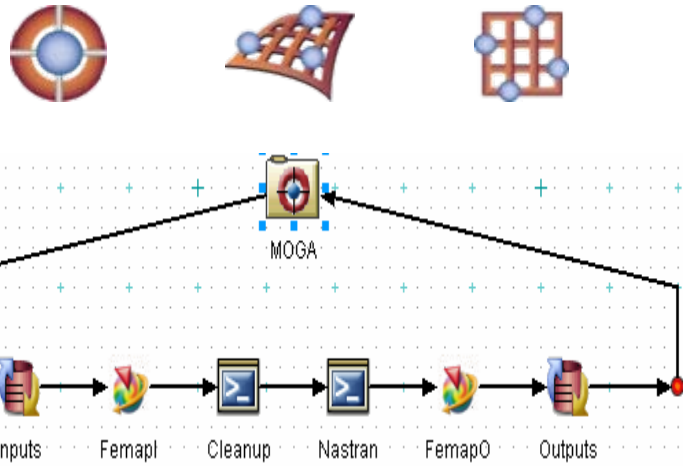
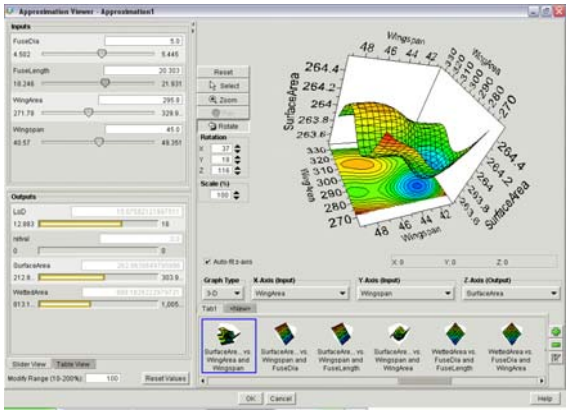
About iSIGHT-FD

- Desktop workflow builder
  - Parametric, hierarchical, nested
  - Drag and drop environment
- Powerful design drivers:
  - Multi-Discipline Optimization
  - Design of Experiments
  - Monte Carlo Analysis
  - Approximation Methods
- Desktop automation
  - Automate simulation process to explore design space
  - Distributed/parallel computing
- Multi-run Visual Post-processing
  - Understand design trade-offs
  - “Surf” through the design space in real-time.





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Functional Overview

iSIGHT-FD Functionality

iSIGHT™-FD

Visualize Process: Advanced GUI provides rich visual feedback of workflow and design exploration results

Connect Process: Modular components make it easy to interface with external programs and post-processing tools

Extend Process: Seamlessly expand from desktop to enterprise level for a true collaborative design environment

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Focus of iSIGHT-FD

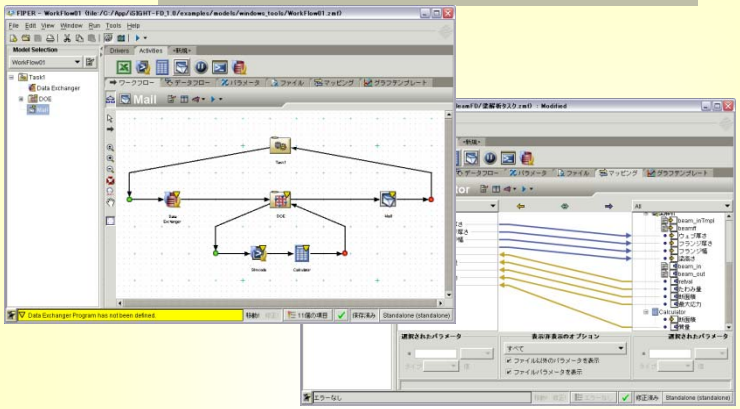
- **Ease of use**
  - **Workflow and setup wizards**
- **Complex process capture and automation**
  - **Task plan, nested drivers, …**
- **Design drivers**
  - **NLPQL, Pointer, OLH, MOGA, etc.**
- **Approximation modeling**
  - **RSM, RBF neural network, error checking**
- **Visualization**
  - **Engineering data mining, design space surfing**
- **Extensibility**
  - **Can be connected to FIPER ACS and other job managing system.**

iSIGHT-FD Structure

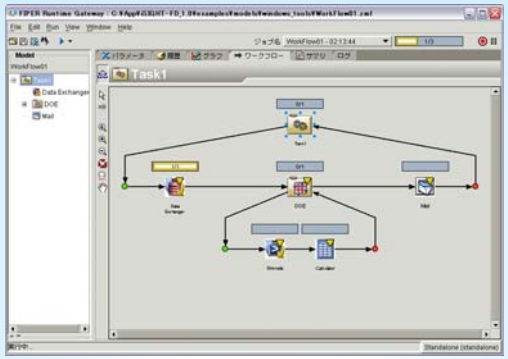
Design Gateway

Runtime Gateway

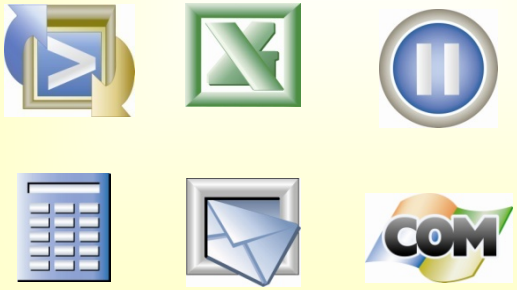
Build Workflow Model



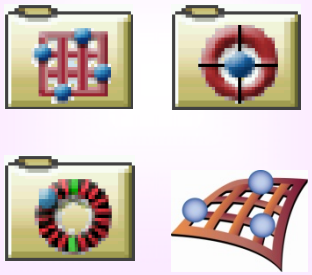
Run Workflow Model



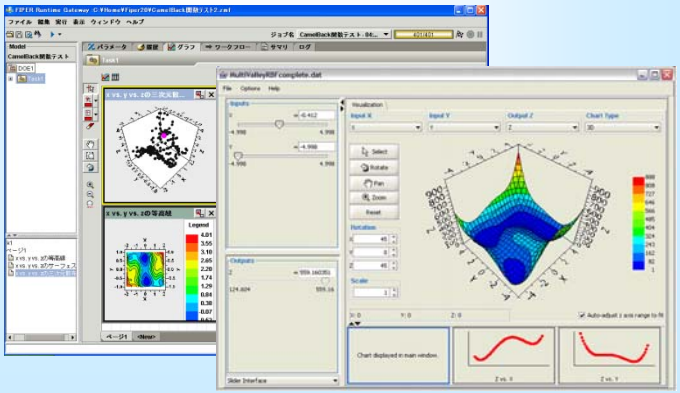
Components



Design Drivers



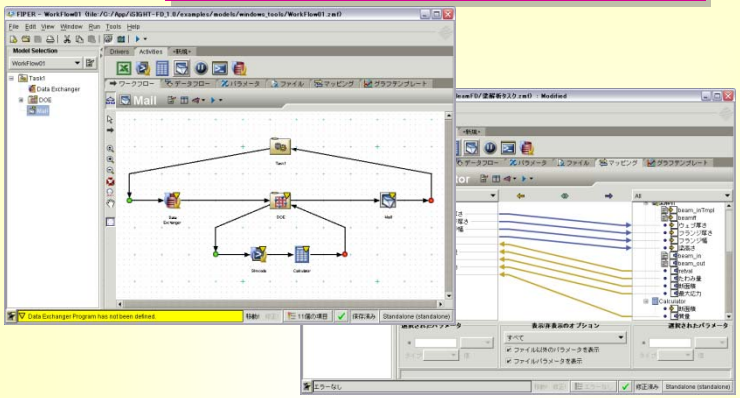
Visualize Data



iSIGHT-FD Operation

Design Gateway

Build Workflow Model

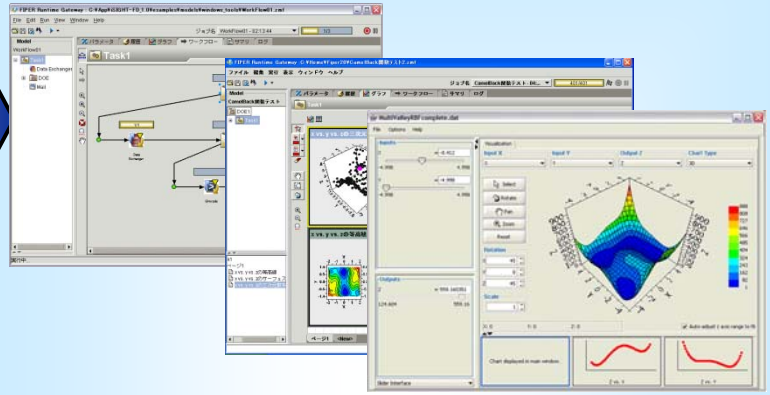


Build process Workflow model

- Select components
- Map parameters
- Establish loop and/or branch controls
- Select optimization/sampling using Task Plan capability
- Select graph templates

Runtime Gateway

Run Workflow Model



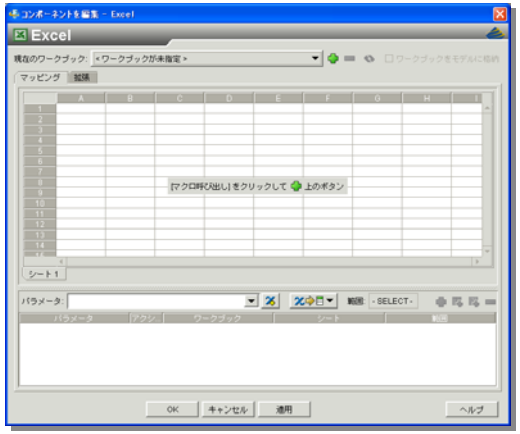
Run Workflow and view/inspect data

- Monitor run status
- View/modify parameters
- Generate history plots
- Display graphs
- Post-processing
  - Engineering Data Mining
  - Visual Design Driver

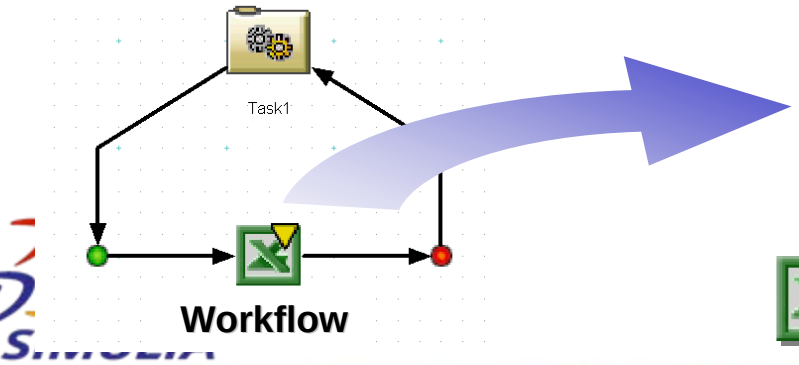
Wrapping Components

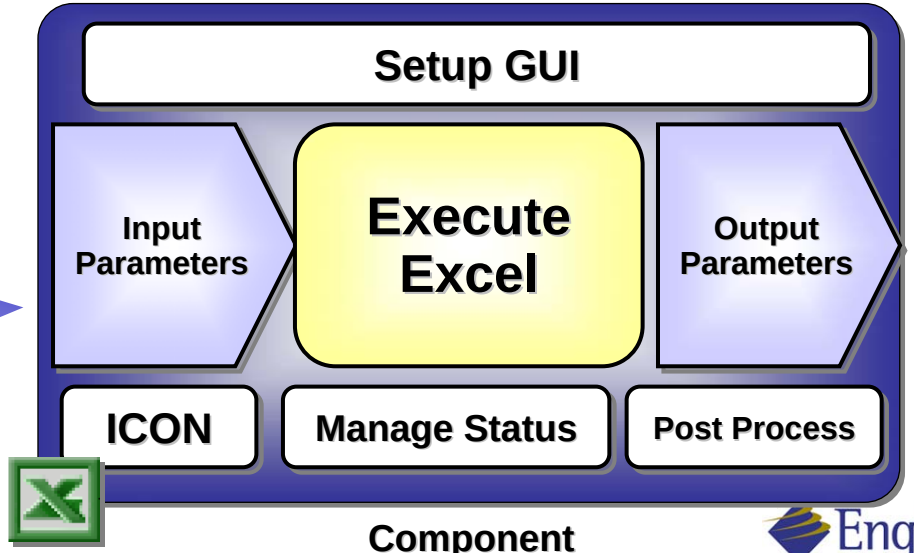
Wrapped software programs that have single or multiple features can be inserted into the iSIGHT-FD Workflow.

- Custom setup GUI is shown to the user
- Input and output parameters are defined
- Icon is created for toolbar
- Program execution is triggered as the workflow is executed
- Status is monitored
- Results are stored



Example: EXCEL Component



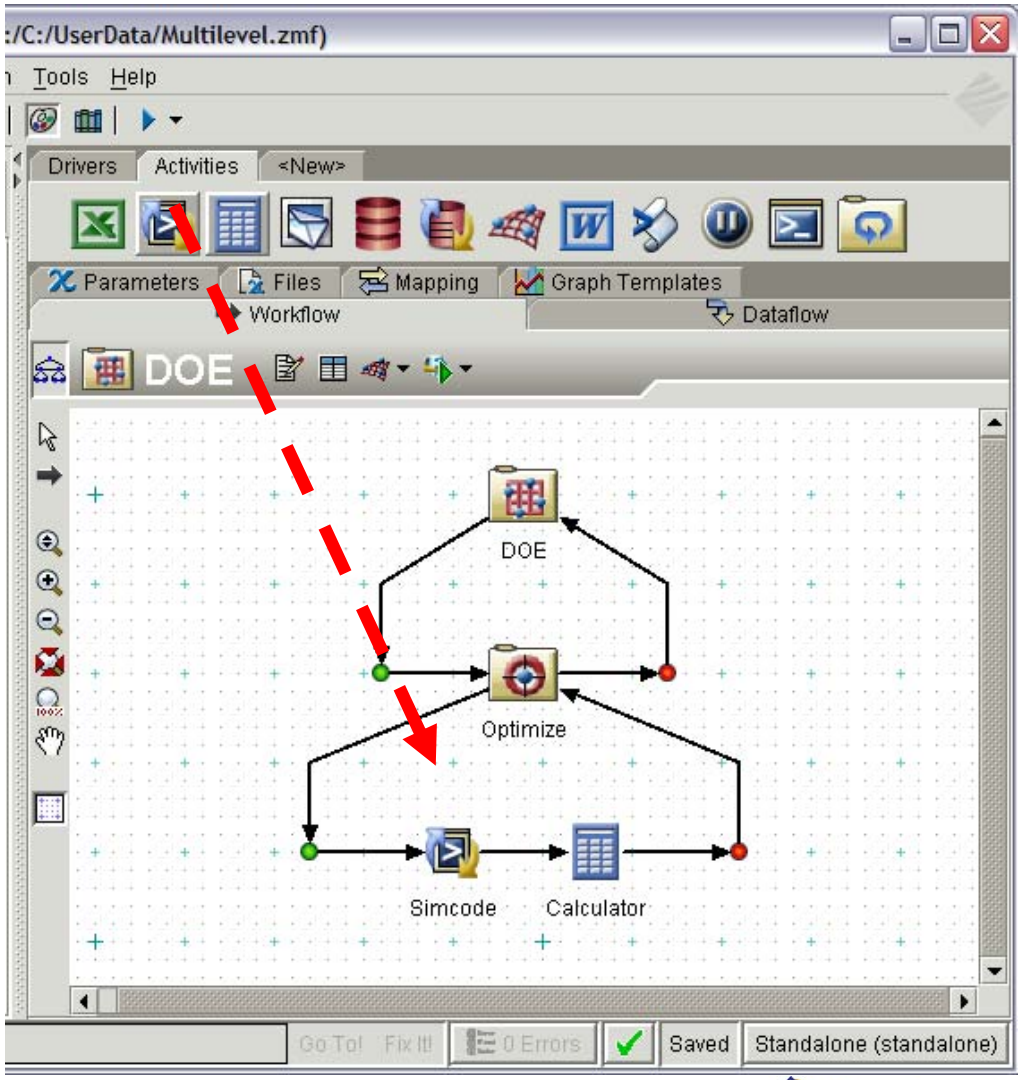


Design Gateway User Interface for Building Workflow Models

Building a Workflow Model

Workflow Components

- Drag & Drop
- Cut & Paste
- Right-click menu
- Shortcut keys
- Multi-level
- Conditional
- Parallel



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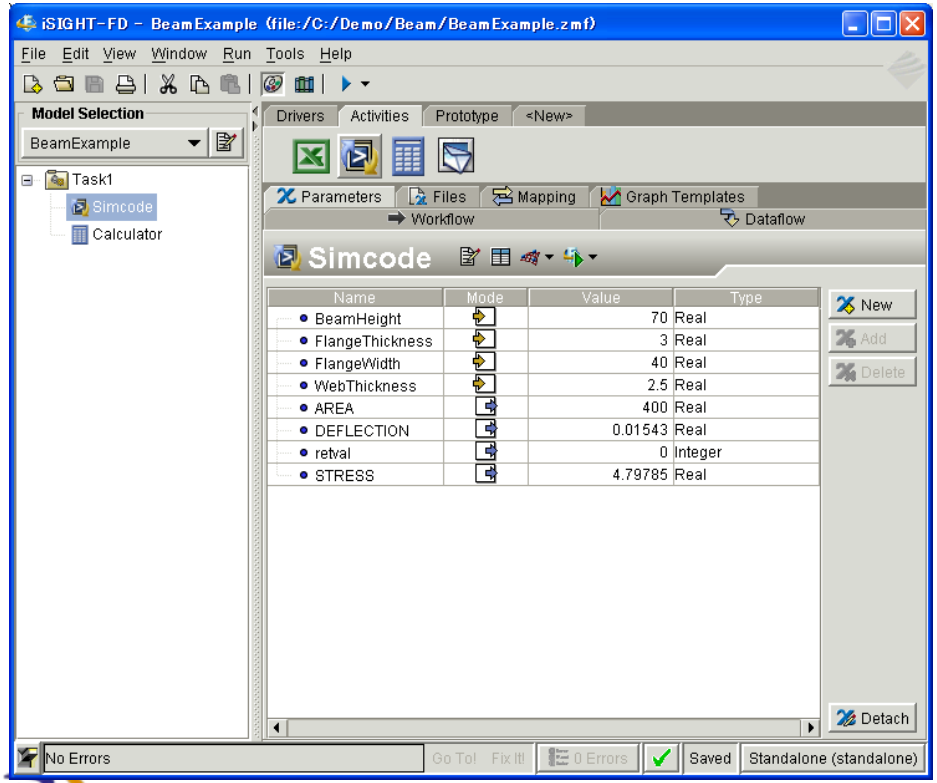
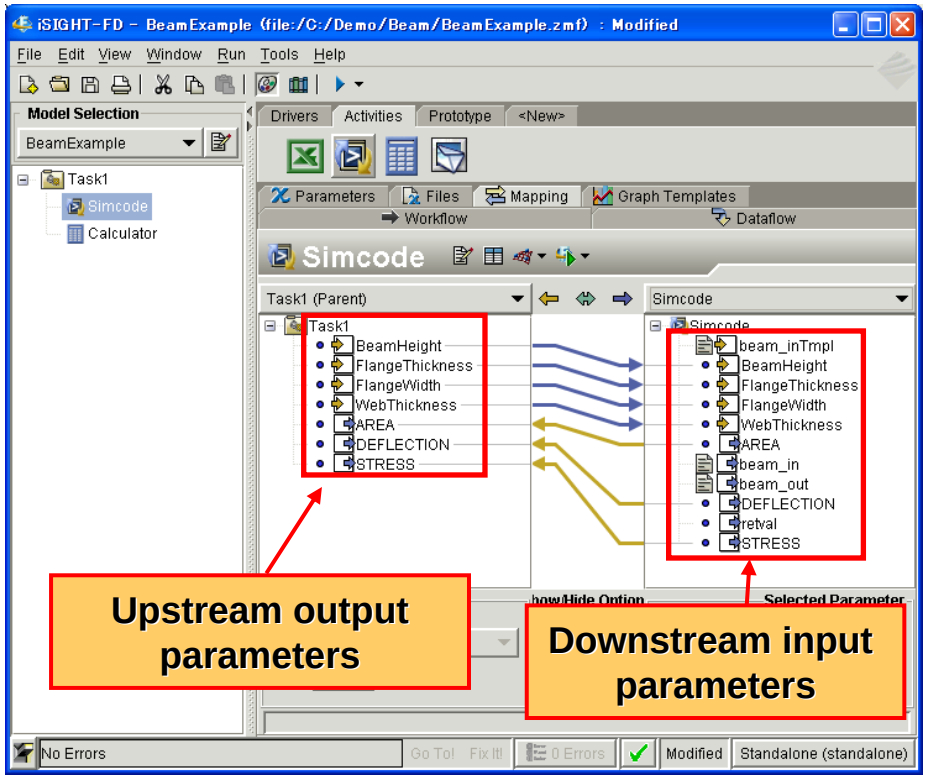
Show and Map Parameters

- Show parameters of each simcode component
- Show parameter mapping between simcodes





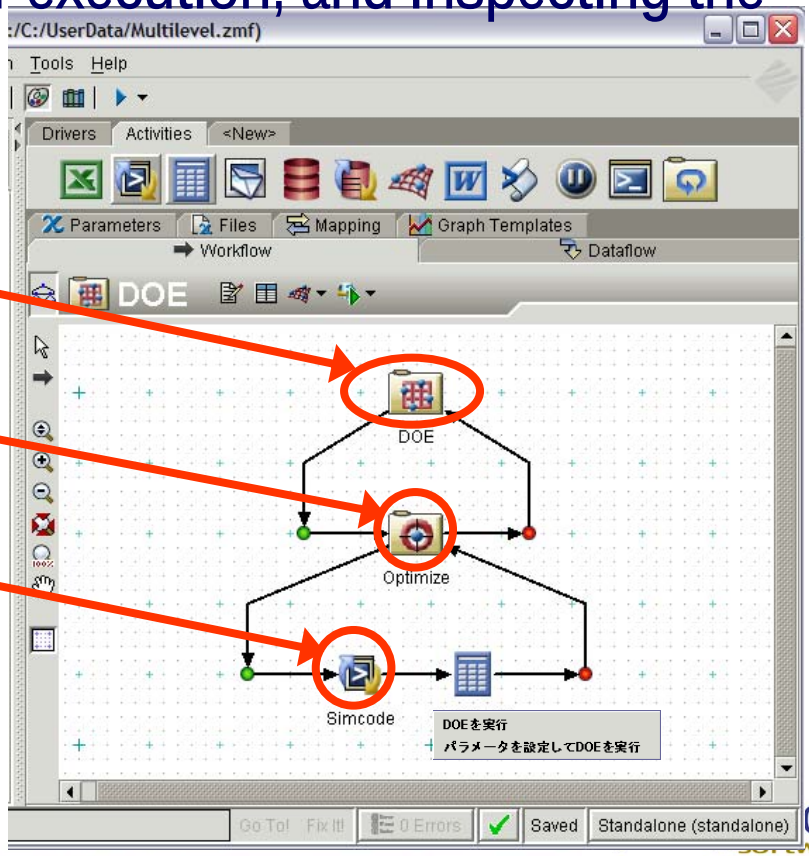
Workflow Model Execution Flexibility

- Can execute an entire workflow, or only individual components
  - Workflow model is easy to build and check by adding components, selecting them for execution, and inspecting the process step-by-step.

Execute a complete model

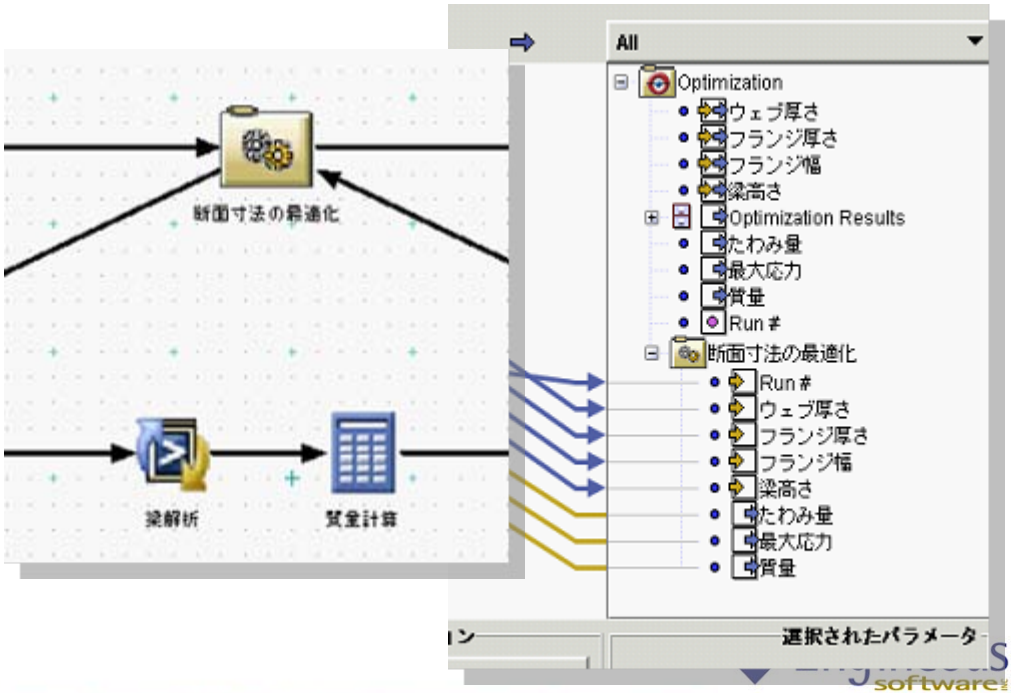
Execute with a sub-model

Execute a selected component



Internationalization (I18N) Environment

- GUI
  - Menu
  - Component name
  - Parameter name
  - Working directory
  - Save model name
  - On-line Help
- Supported OS:
  - Windows
  - Linux
  - Solaris
  - AIX
  - HP-UX



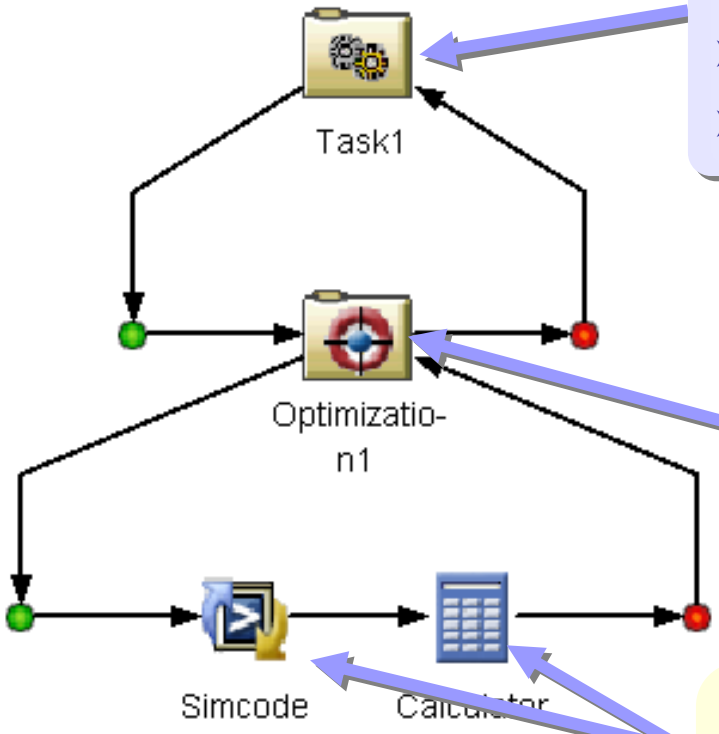
iSIGHT-FD Components

Process Component

Activity Component

Design Driver Component

Definition of Components



Process Component

- Contains sub-models
- Controls sub-models

Design Driver Component

- Optimization
- Design of Experiments
- Monte Carlo Simulation
- Approximation models

Activity Component

- Calculations and simulation codes
- Set conditions to execute features
- Execute

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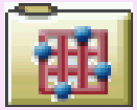
iSIGHT-FD Process Components

- Process Components

- Task — Fundamental process component; Execute Sub-workflow

- Loop — Control iteration of sub-workflow; For, For each, Do Until



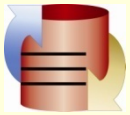
- DOE — Design of Experiments methods

- Optimization — Optimization methods

- Monte Carlo — Monte Carlo methods

iSIGHT-FD Activity Components

Activity Components used to build automated Workflows:

 Data Exchanger	Read and write numerical values and character string data described in a text file
 OS Command	Execute commands, batch files, scripts
 Simcode	Execute simulation codes and read and write associated input and output files, execute commands
 Calculator	Calculate with parameters and functions
 Excel	Read and write cells in Microsoft Excel spreadsheets, execute macros
 Word	Read and write Microsoft Word documents to generate reports automatically
 Mail	Send e-mail containing results and data generated during execution, attach data files

iSIGHT-FD Activity Components

Activity Components used for various purposes:

 Database	Interface with SQL compliant rational database (Oracle, DB2, Access, MySQL) to store input and output data
 Script	Execute Java script which is not necessary to be compiled
 COM	Interface with COM (Component Object Model) objects
 Pause	Pause the workflow during execution with conditional settings. Shows a dialog to determine “go” or “no go.”
 iSIGHT	Execute iSIGHT description file
 Approximation	Generate, inspect, and visualize approximation models

Solution Components

Direct Interfaces – CAD, CAE, CFD, COST, DB, Microsoft Apps, Etc.


General Interfaces – Calculations, In-House Programs, Scripts, Etc.


Calculator


Simcode

COM Link


E-mail


Data Match

XML Parser

DLL Link


Text Parser


Pause


Script


OS Command

Custom Interfaces – User Developed or Engineous Services

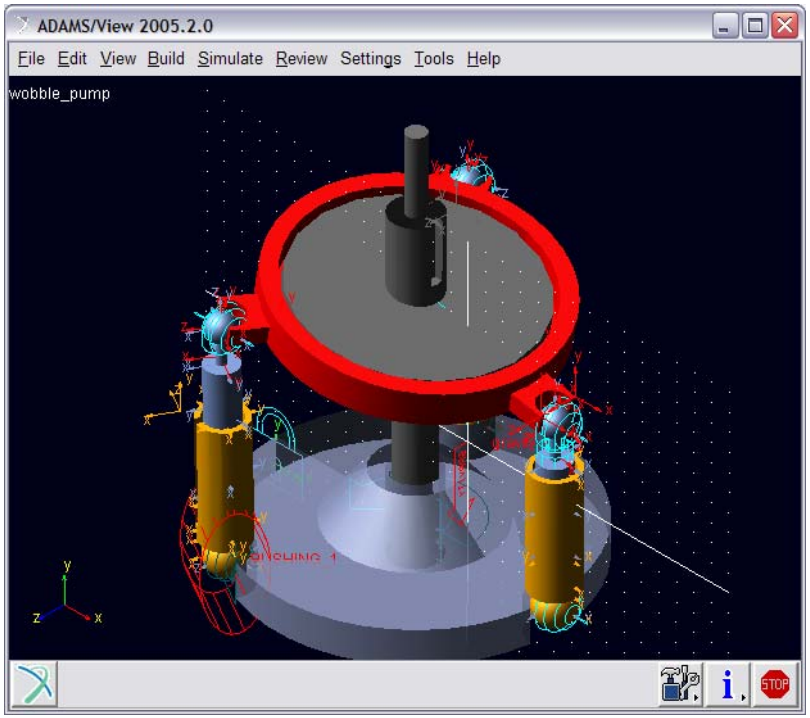
Customer Examples:

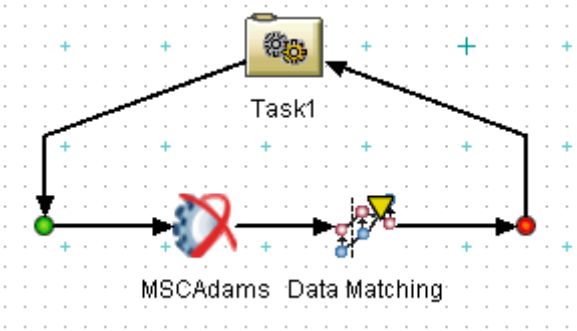

Combat XXI


Vensim

Solution Components Suite

- CAE Performance Simulation
  - Abaqus: Exchange data with and execute Abaqus FEA
  - ADAMS: Exchange data with and execute ADAMS/View
  - ADAMS/Car: Exchange data with and execute ADAMS/Car
  - ADAMS/Chassis: Exchange data with and execute ADAMS/Chassis
  - AMESim: Exchange data with AMESim
  - Ansys Solver: Exchange FEA data with Ansys and execute the solver





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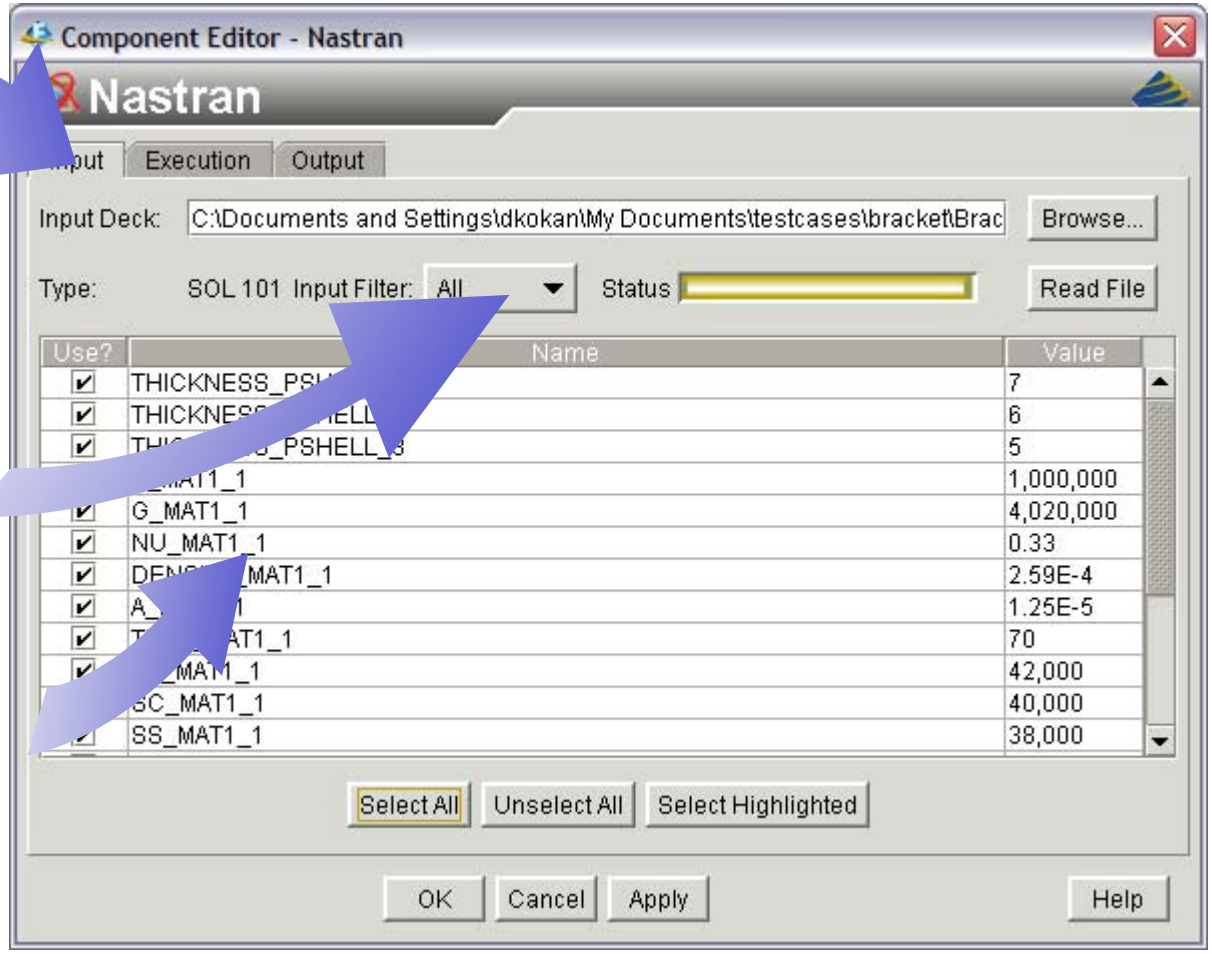
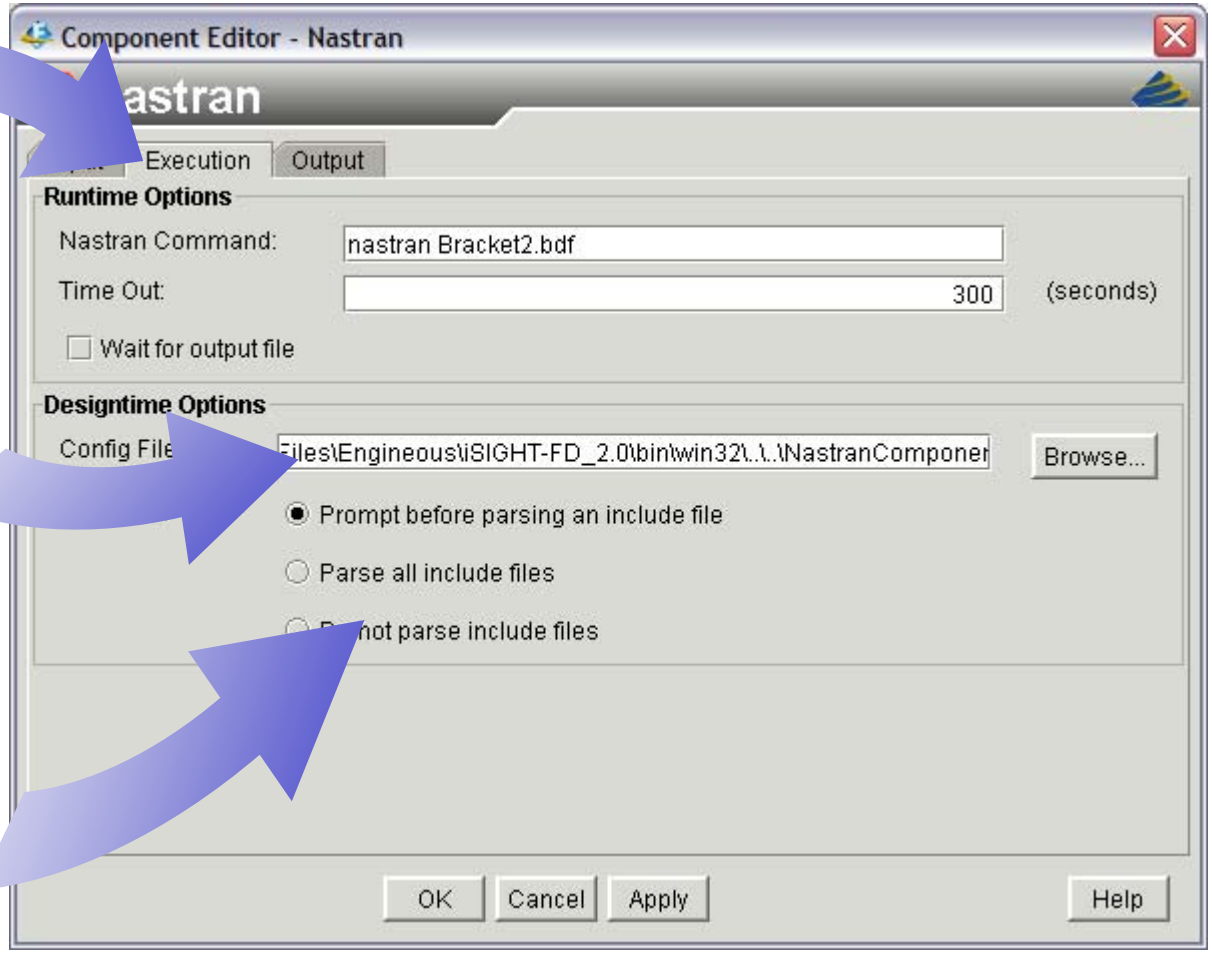
Ex: Nastran Component Editor

- Input tab defines input bulk data file
- Filter by load, element property, material, etc.
- Select which input parameters to expose to iSIGHT



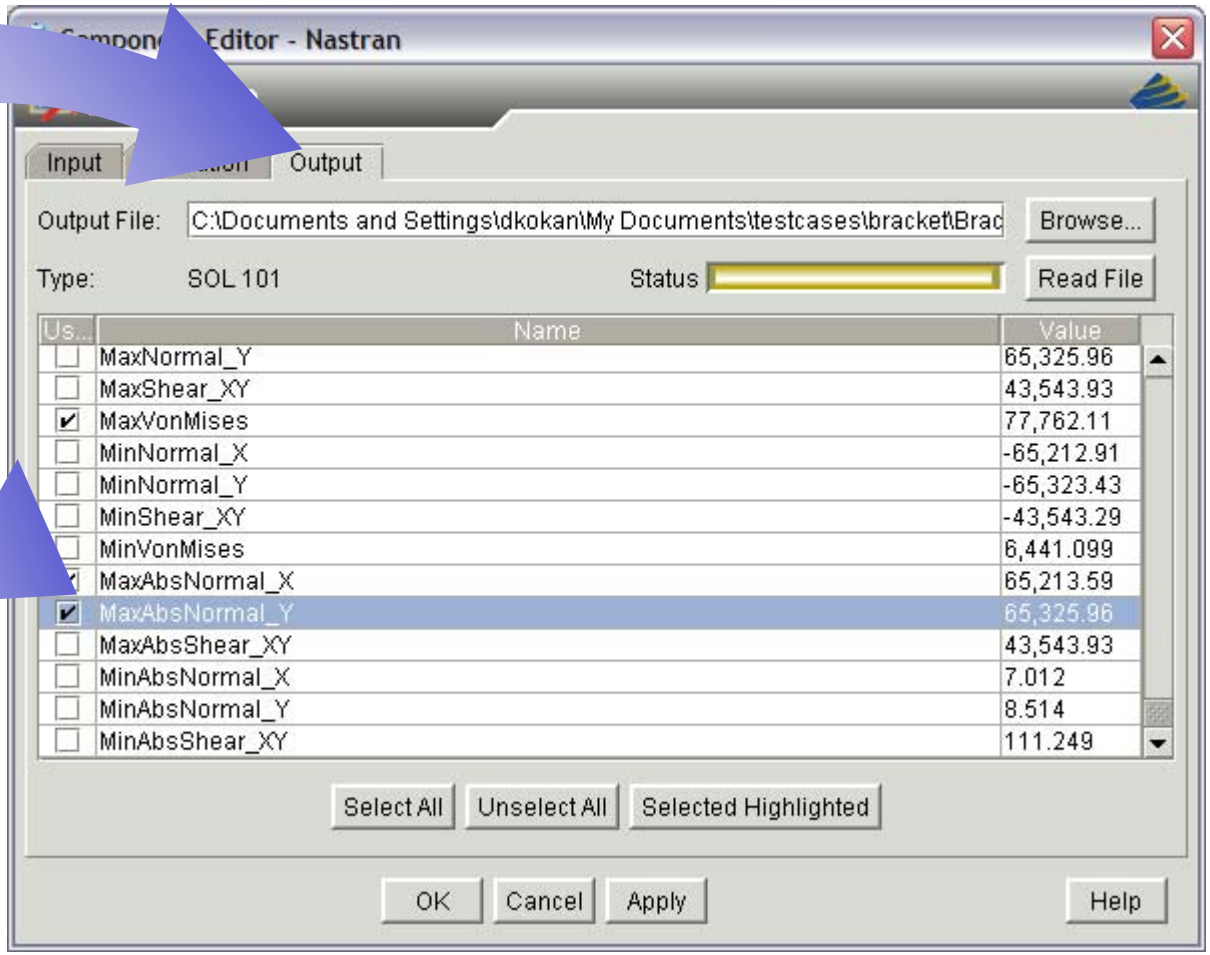
Nastran Component Editor

- Execution tab defines Nastran command line and other runtime behavior
- User can configure which parameters are supported through a configuration file
- User can control how INCLUDE files are handled



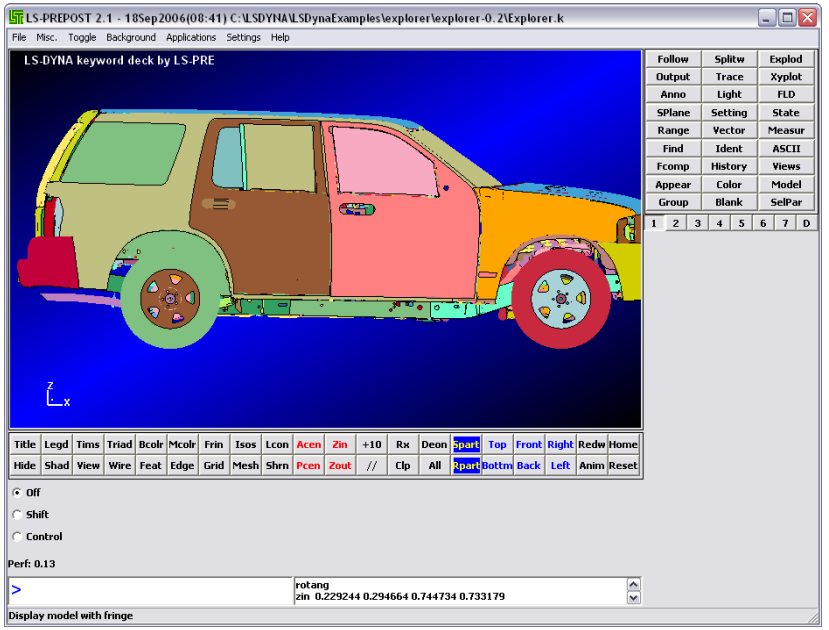
Ex:Nastran Component Editor

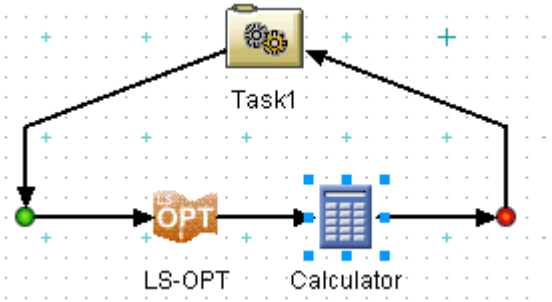
- Output tab defines output f06 file to be parsed
- Select which output parameters to expose to iSIGHT



Solution Components Suite

- CAE Performance Simulation
  - Ansys Workbench: Exchange FEA data with Ansys Workbench and execute Ansys solver
  - AVL: Exchange data with and execute AVL solvers
  - Femap: Exchange FEA data with Femap, execute Nastran and other solvers
  - Flotherm: Exchange data with Flotherm CFD
  - GT-Power Engine Combustion: Exchange data with and execute GT-power engine simulation software
  - LS-DYNA/LS-OPT: Exchange data with and execute LS-DYNA through LS-OPT

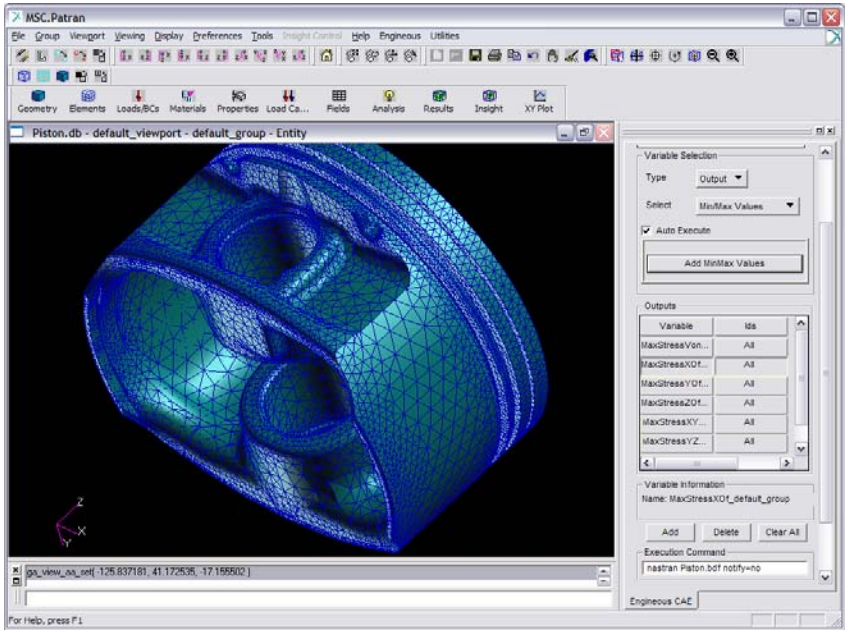


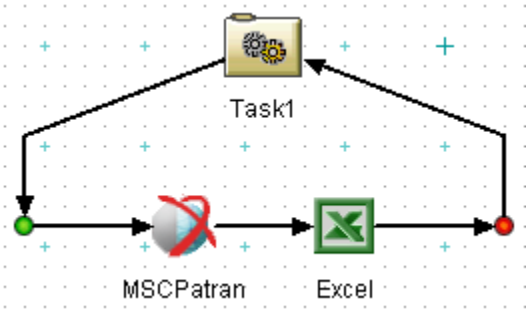


Solution Components Suite

- CAE Performance Simulation

  - Madymo Occupant Safety: Exchange data with Madymo generic multibody and FEA software
  - Nastran: Exchange FEA data with Nastran and execute the solver
  - Patran: Exchange geometry and FEA data with Patran, launch Nastran, Marc, and other solvers
  - SimulationX: Exchange data with and execute ITI SimulationX
  - STAR-CCM+: Exchange data with and execute STAR-CCM+ CFD





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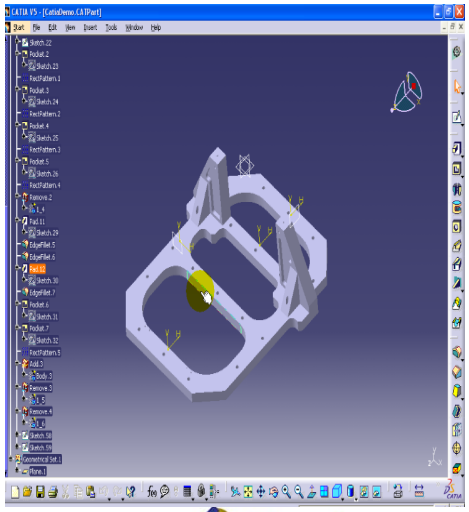
Solution Components Suite

- CAD Geometry Modification
  - CATIA V5 CAD Driver: Exchange CAD data with CATIA V5
  - CATIA V5 CAT_Analysis: Exchange CAD and simulation data with CATIA embedded analysis tools
  - Pro/E CAD Driver: Exchange CAD data with ProEngineer
  - Unigraphics CAD Driver: Exchange CAD data with Unigraphics
- Geometry to CAE
  - Abaqus: Create an Abaqus input deck from CAD geometry
  - SFE Concept: SFE Concept



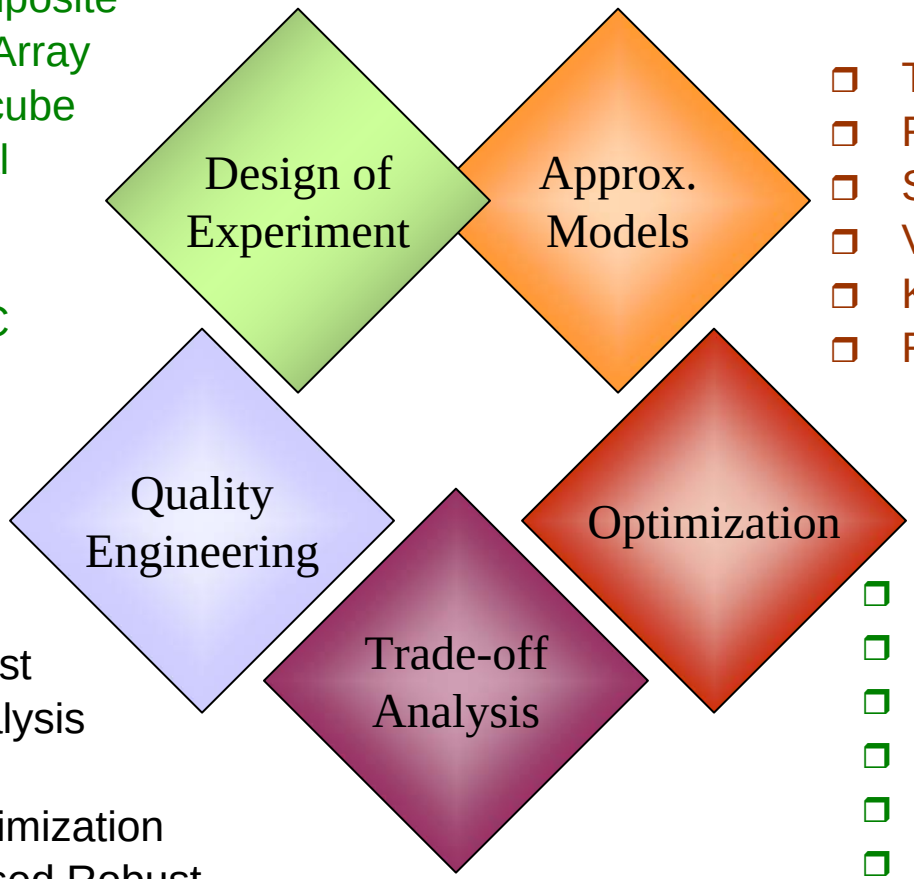
iSIGHT™-FD

Design Drivers

Task Plan
Optimization Component
DOE Component
MCS Component
Approximation Model
Visual Design Driver

Design Study Tools

- Central Composite
- Orthogonal Array
- Latin Hypercube
- Full Factorial
- Parameter
- Data file
- Optimal LHC



- Taylor series
- Response Surface
- Stepwise RSM (9.0)
- Variable complexity
- Kriging
- RBF

- Monte Carlo
- Taguchi Robust
- Reliability Analysis

- Reliability Optimization
- Reliability–based Robust Design

- Rule-based (2)
- Exploratory (3)
- Gradient-based (7)
- Mixed Variable (2)
- Pointer
- Stochastic Design Improvement (SDI)

- Multi-objective GAs
- Engineering Data Mining

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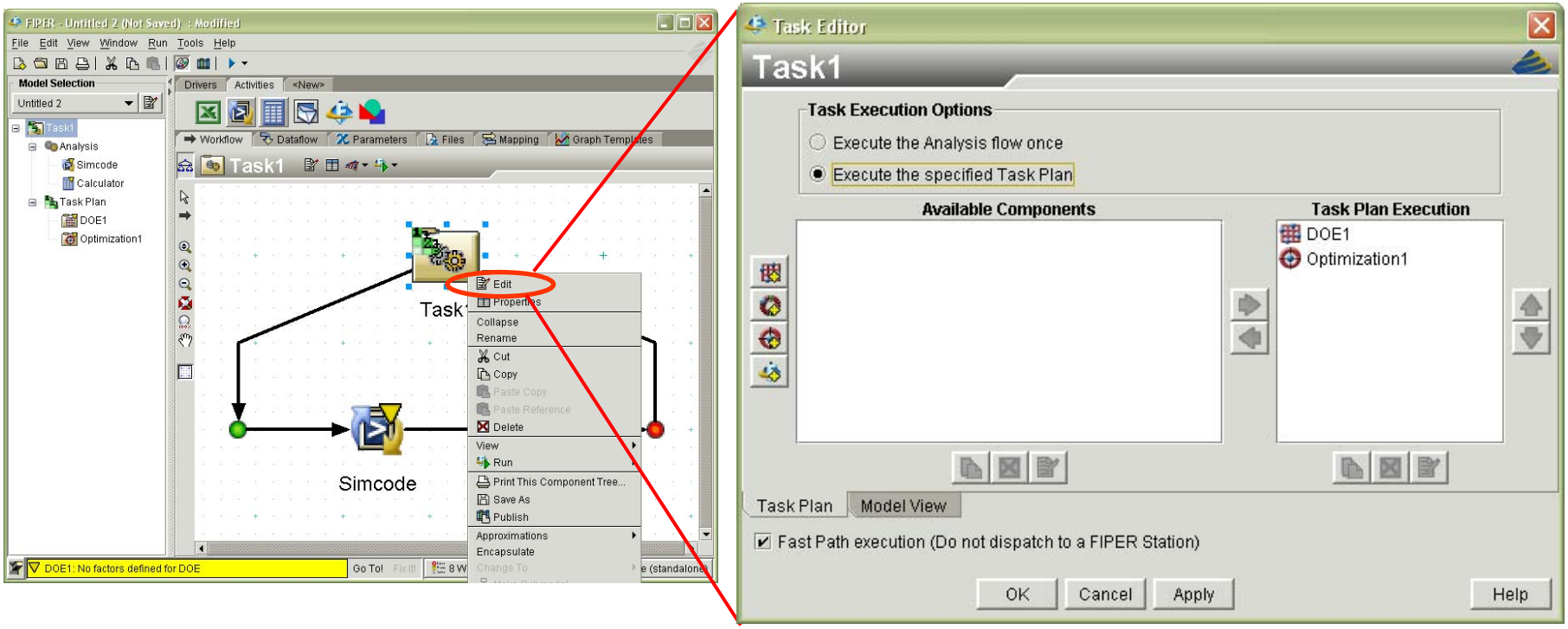
Task Plan

- Create Task Plan to execute combinations of multiple design drivers

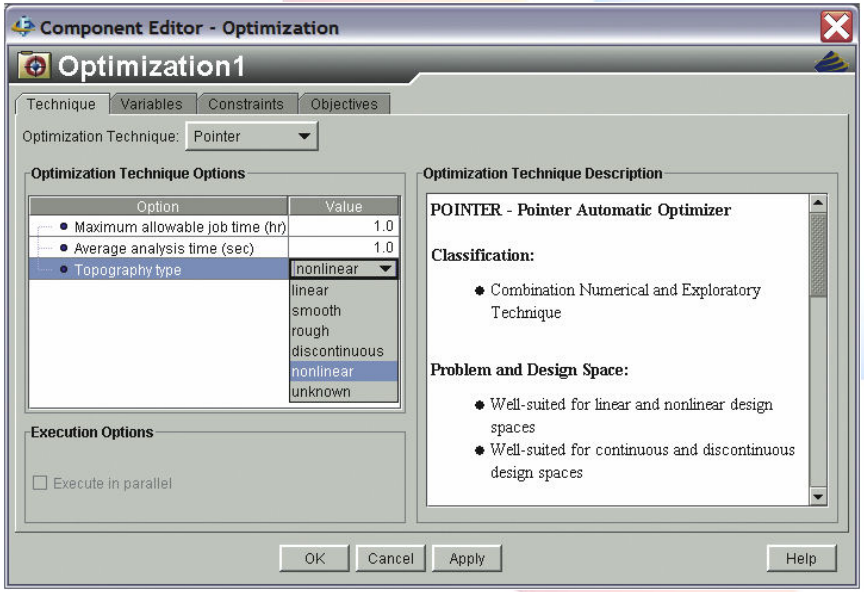
Equivalent to iSIGHT Task Plan



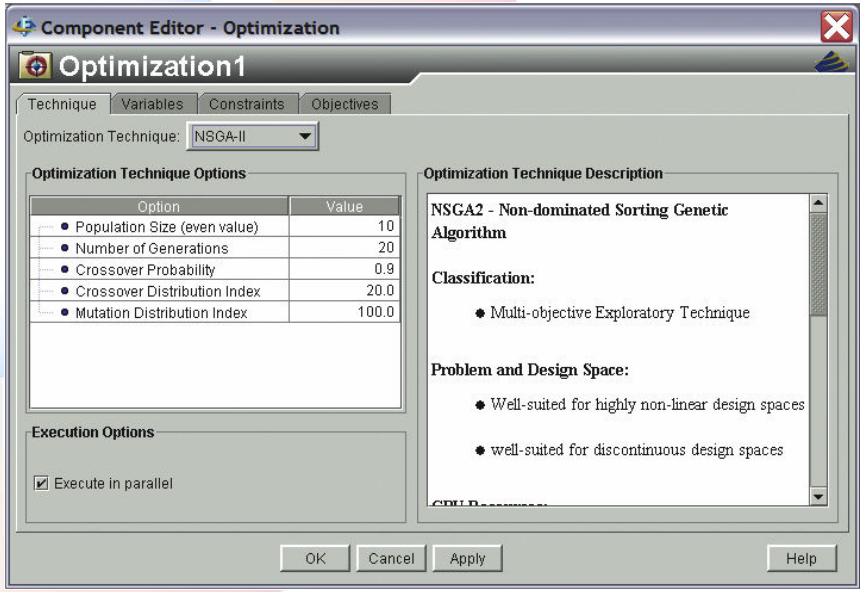
Task Plan GUI

Optimization Component

- Some optimization components available
  - NLPQL, Hooke-Jeeves, LSGRG2
  - Multi-island genetic algorithm (MIGA)
  - Pointer automatic optimizer
  - Multi-objective genetic algorithms (NSGA-II, NCGA)



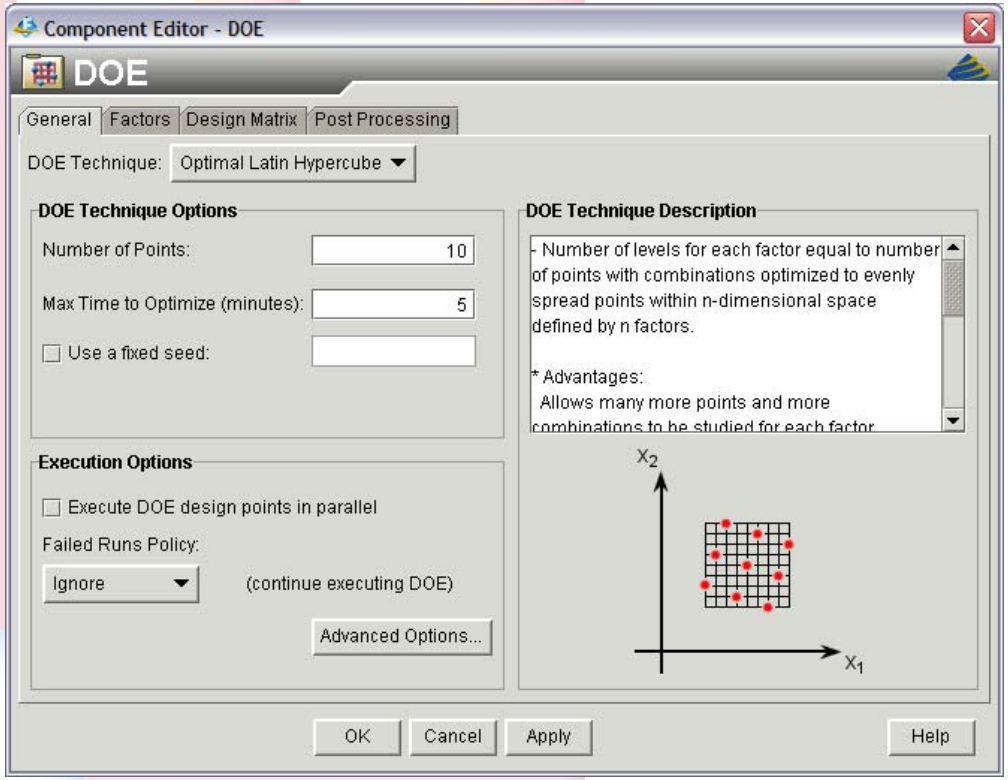
Pointer Component Editor GUI



NSGA-II Component Editor GUI

Design Of Experiments Component

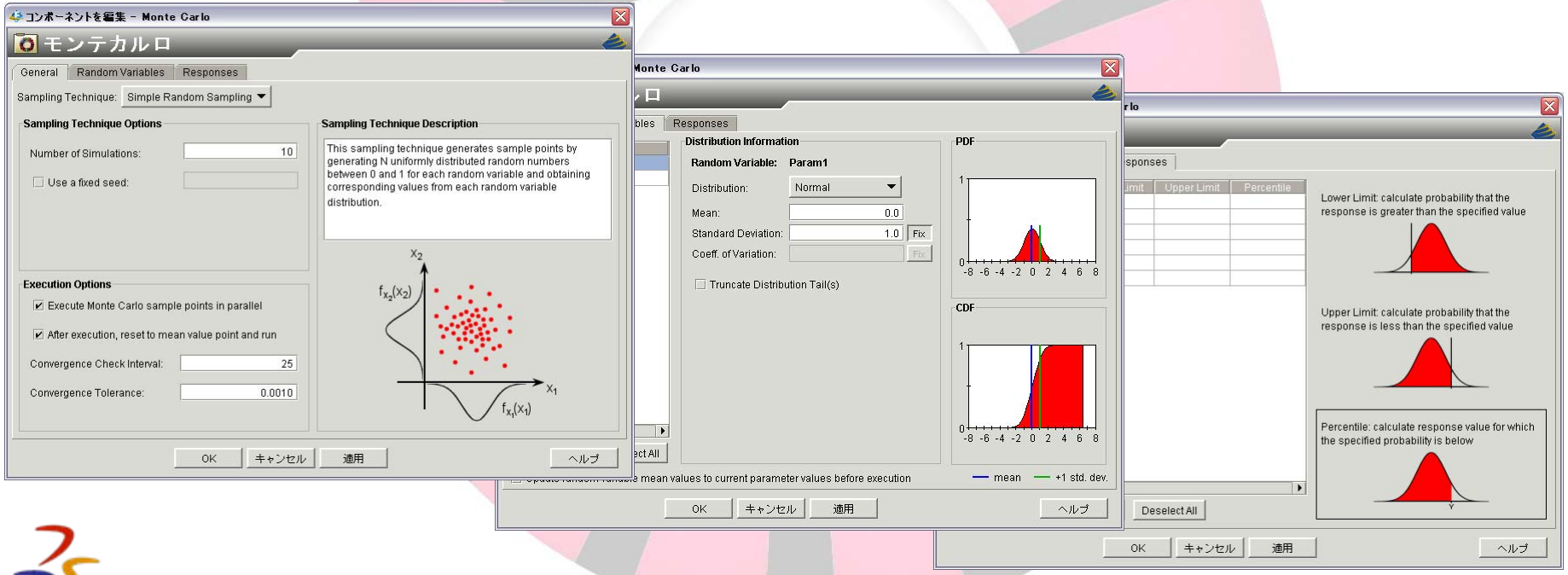
- DOE component methods available in v1.0
  - Central Composite
  - Data File
  - Full Factorial
  - Latin Hypercube
  - Optimal Latin Hypercube
  - Orthogonal Array
  - Parameter Study



DOE Component Editor GUI

Monte Carlo Simulation Component

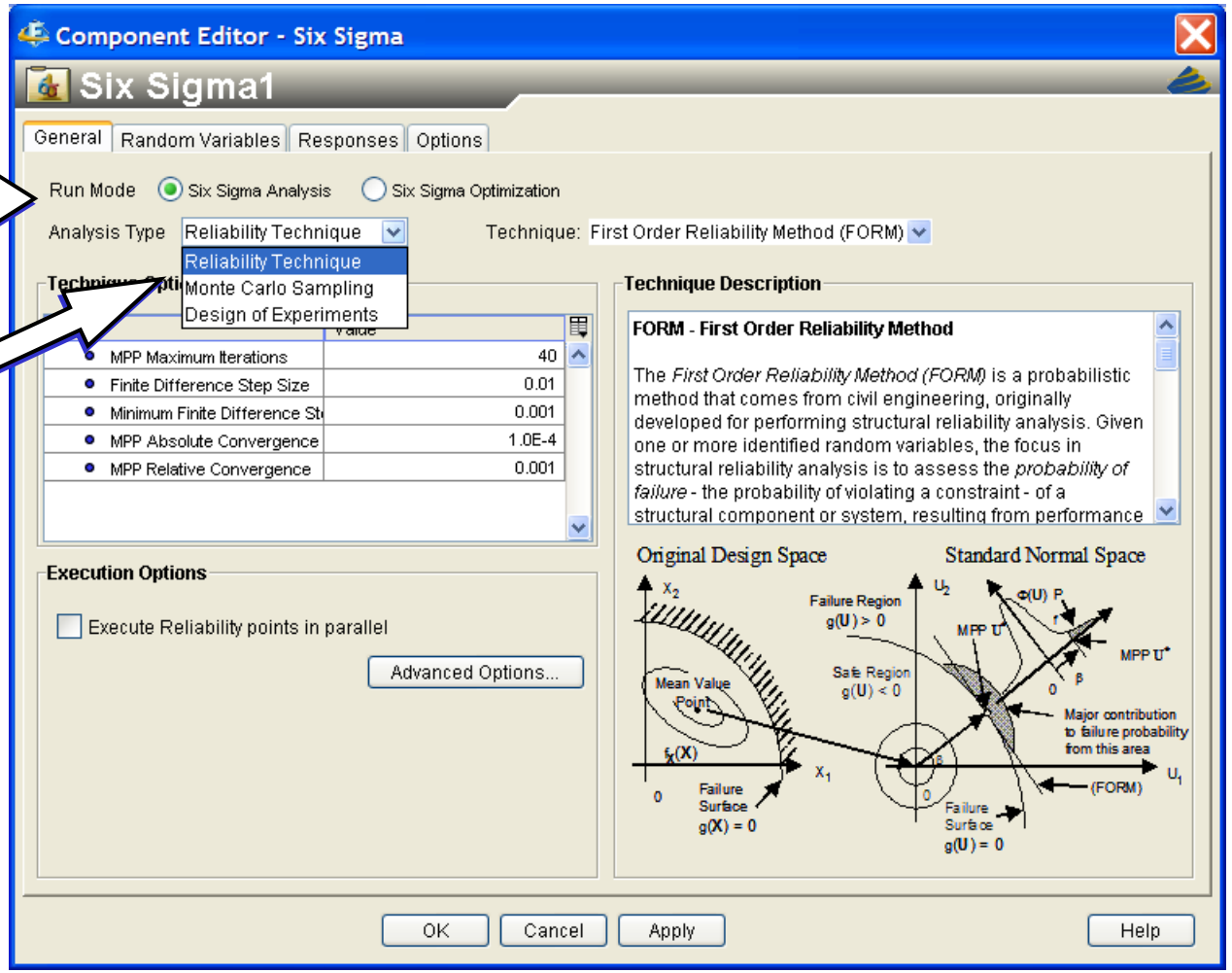
- Monte Carlo Simulation component
  - Sampling methods
    - Simple Random Sampling
    - Descriptive Sampling



Monte Carlo Component Editor GUI

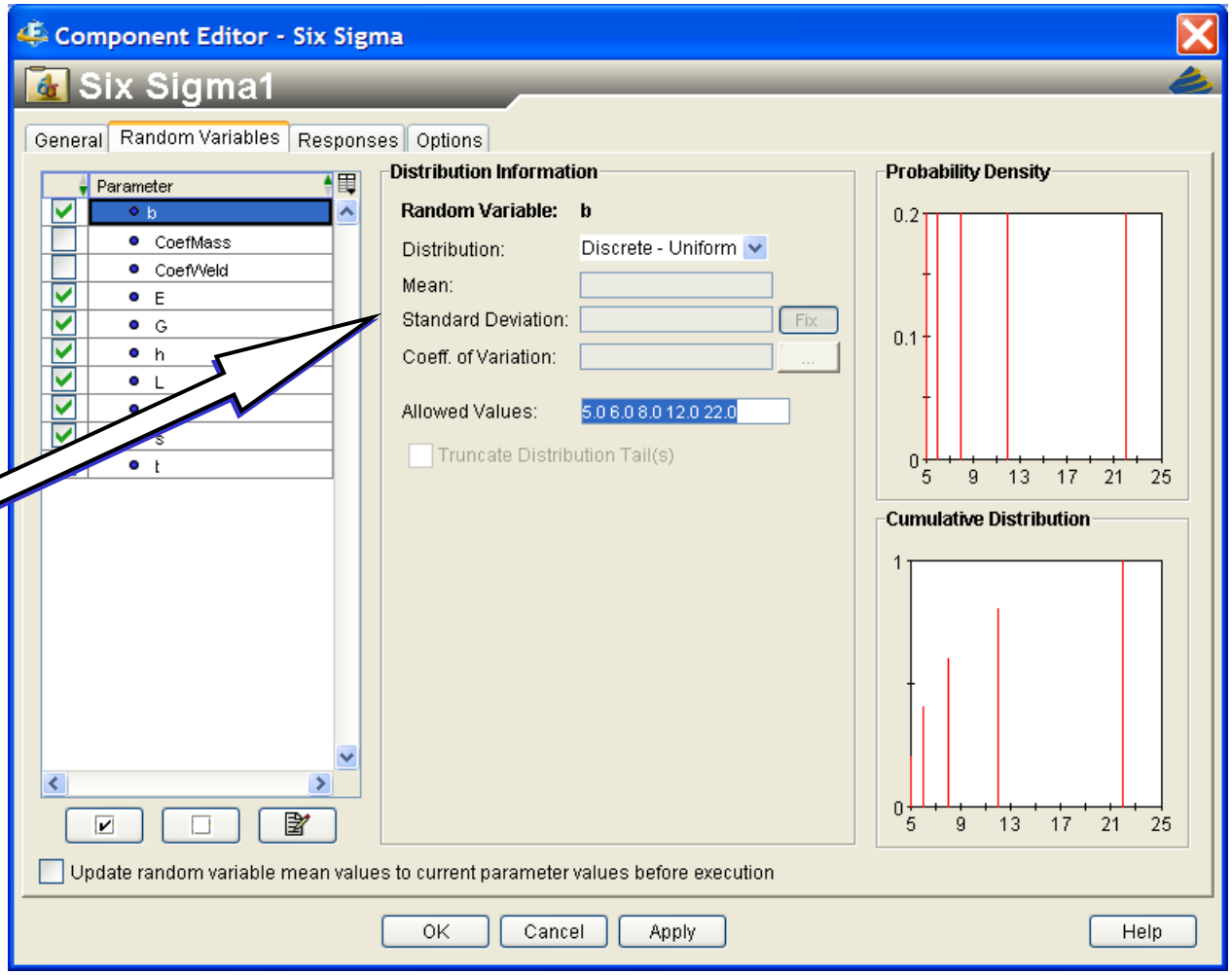
Six Sigma Component (cont.)

- General Setup
  - Run mode
    - Analysis
    - Optimization
  - Classes of plugins
    - Reliability Techniques
    - Monte Carlo Sampling
    - DOE
  - Description
  - Execution Options



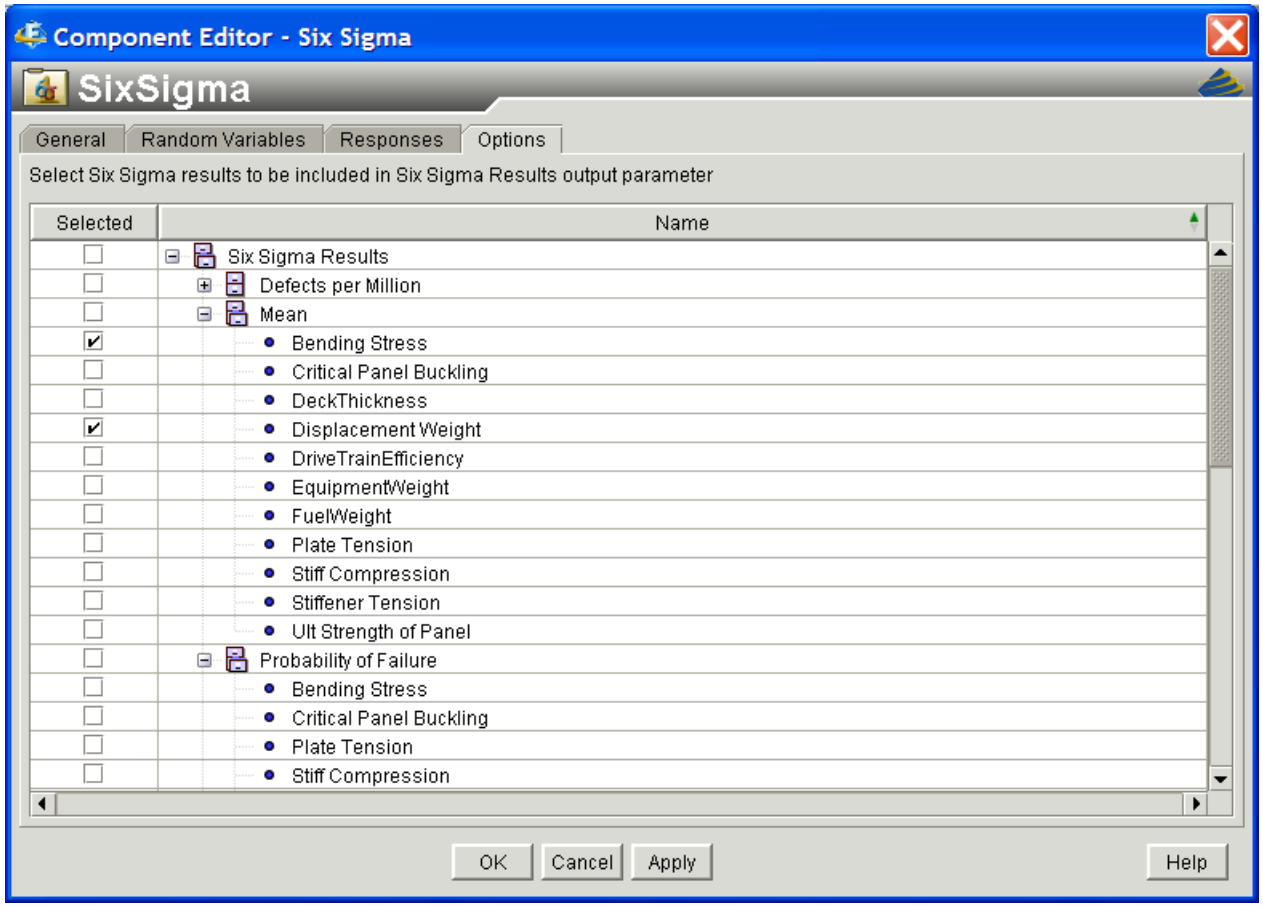
Six Sigma Component

- Random Variables and Responses tabs same as Monte Carlo
- New “Discrete-Uniform” distribution



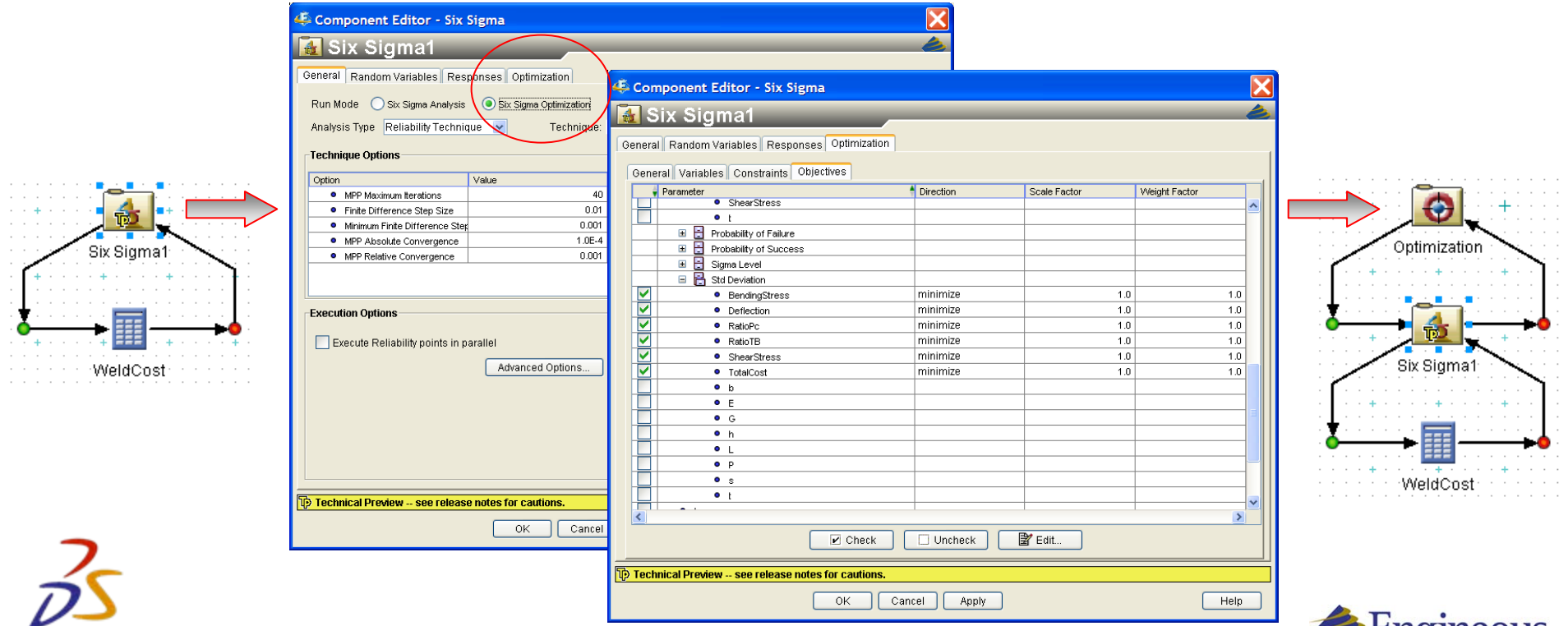
Six Sigma Component (cont.)

- Six Sigma Results parameter
- Select outputs to be included in aggregate parameter
- Allows mapping to other component to drive *designing for uncertainty* quality improvement process



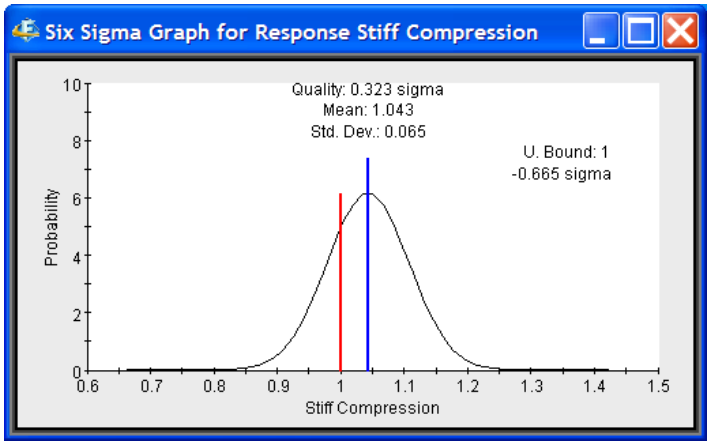
Six Sigma Component (cont.)

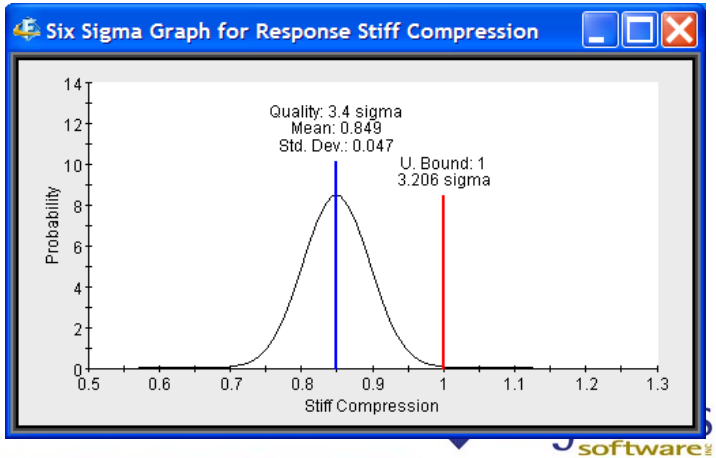
- Optimization configured within Six Sigma component editor
- Robust optimization option creates model with six sigma component embedded in optimization component



Six Sigma Results

- Six Sigma Component methods/results include:
  - Six Sigma Analysis
    - Sigma Level / Quality Level
    - Defects per million
  - Reliability Analysis
    - Reliability (probability of success)
    - Probability of failure
  - Statistics
    - Mean, Standard deviation, etc.
  - Robust / Reliability Optimization



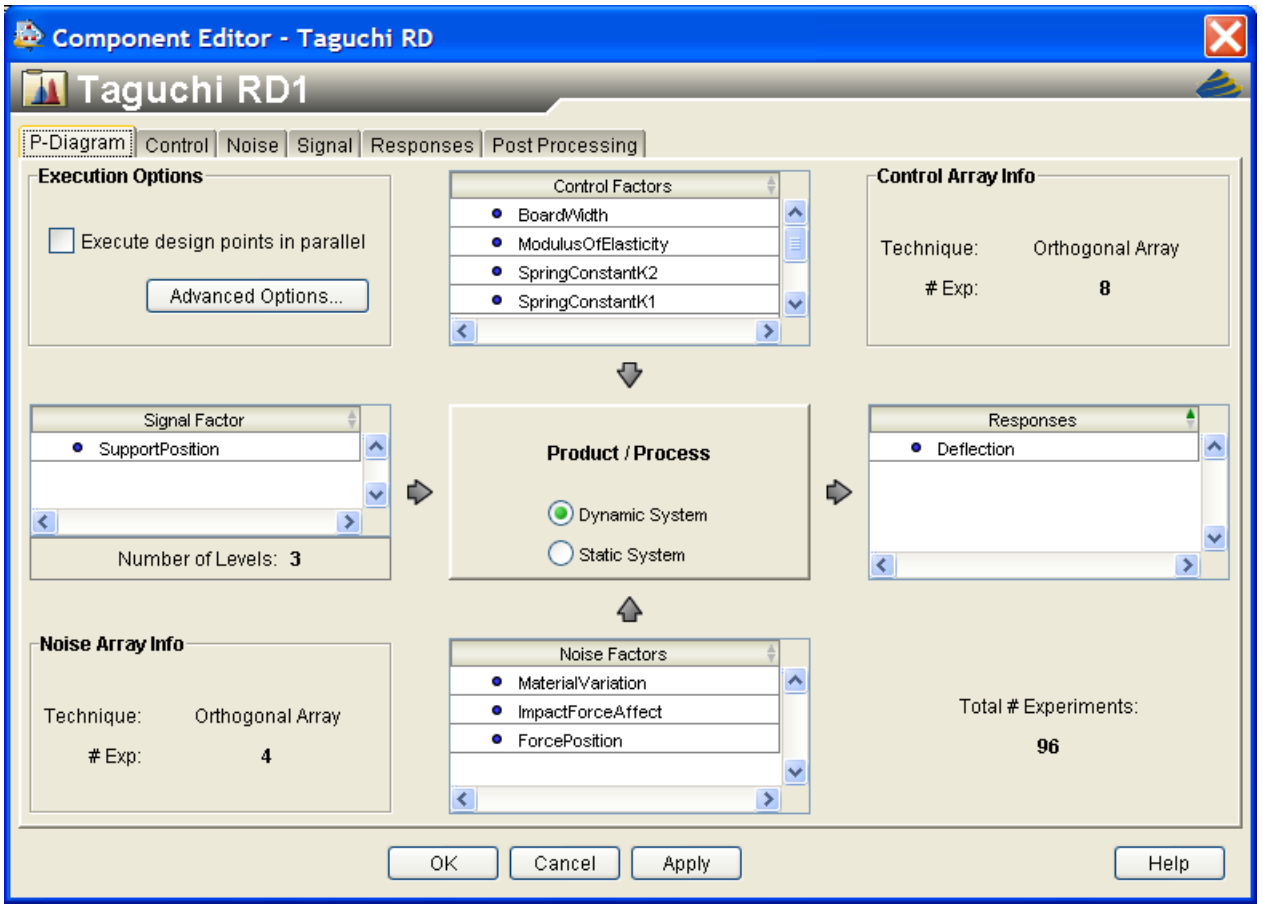


Six Sigma Table

Row #		Parameters for all Iterations (Done)			
		6 of 6 rows are shown			
		Sigma Level	Probability of Success	Probability of Failure	Defects per Million
1	Bending Stress	8.0	1.0	0.0	0.0
2	Critical Panel Buckling	8.0	1.0	0.0	0.0
3	Plate Tension	1.4378203	0.849515	0.150485	150485.0488645
4	Stiff Compression	0.3225107	0.2529341	0.7470659	747065.8561221
5	Stiffener Tension	8.0	1.0	0.0	0.0
6	Ult Strength of Panel	8.0	1.0	0.0	0.0

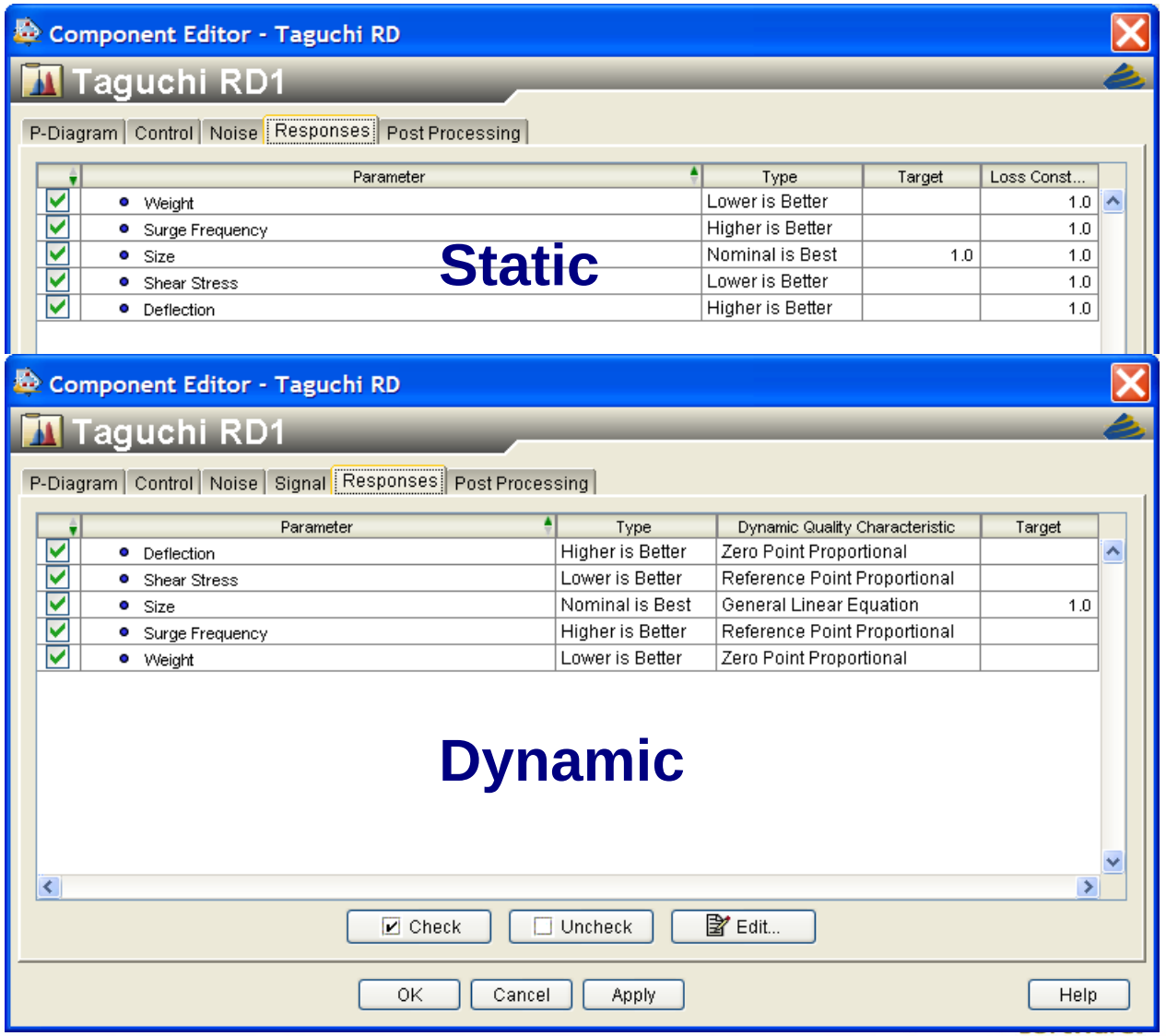
Taguchi Component

- P-Diagram summary of setup
  - Control Factors, Array
  - Noise Factors, Array
  - Signal Factor, number of levels
  - Responses
  - System type defined up front:
    - Static
    - Dynamic



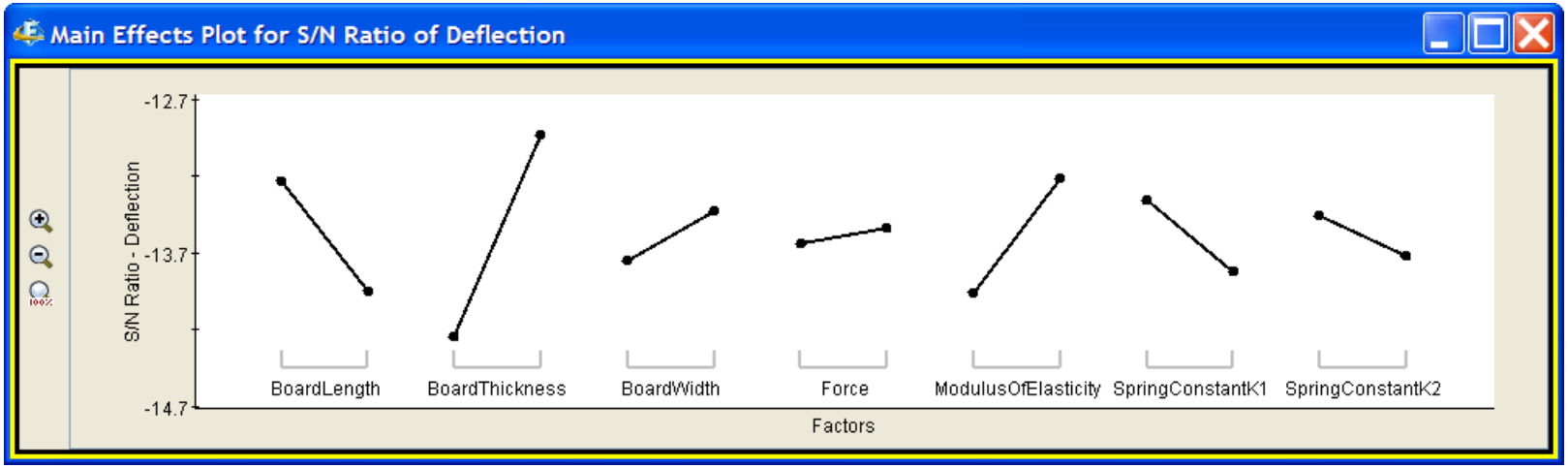
Taguchi Component (cont.)

- Response Definition
  - Customized for static or dynamic system
  - Type:
    - Lower is better
    - Nominal is best
    - Higher is better
  - Dynamic quality characteristic
    - Zero point proportional
    - Reference point proportional
    - General linear equation
  - Target
  - Loss constant

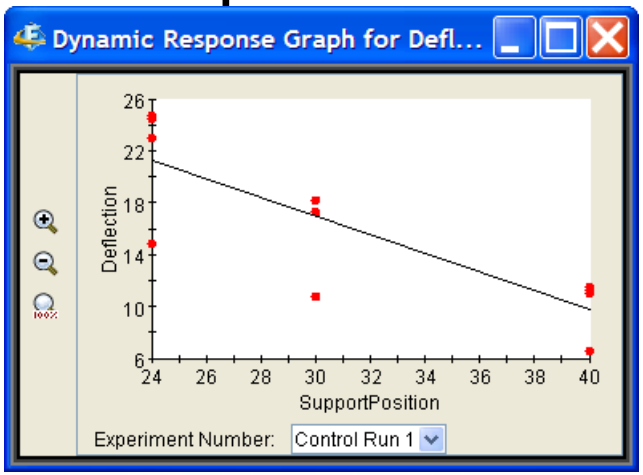


Taguchi Robust Design Results

- Main Effects Graph



- Dynamic Response Graph



Taguchi Robust Design Results (cont.)

- Taguchi Results Table

Static

Taguchi Results Table for Deflection

	Control #	S/N Ratio	Mean	Variance	Loss
1	1.0	0.84115	0.61875	0.050999	0.82392
2	2.0	0.48361	0.36458	0.14166	0.89462
3	3.0	-1.1636	-0.76506	1.0931	1.3073
4	4.0	-2.9763	-1.9418	3.0363	1.9844

Dynamic

Taguchi Results Table for Deflection

	Control #	S/N Ratio	Sensitivity	Beta	St	Sb	Se	Ve
1	1.0	-14.107	-2.9293	-0.71373	391.25	266.25	124.99	12.499
2	2.0	-12.186	-10.013	-0.31576	68.099	52.112	15.987	1.5987
3	3.0	-13.028	-7.3687	-0.42812	131.24	95.799	35.444	3.5444
4	4.0	-15.23	-3.5638	-0.66345	368.03	230.06	137.97	13.797
5	5.0	-13.425	-6.1808	-0.49086	176.81	125.93	50.878	5.0878
6	6.0	-13.206	-4.9922	-0.56285	229.31	165.58	63.729	6.3729
7	7.0	-14.449	-1.4032	-0.85082	569.81	378.36	191.45	19.145
8	8.0	-13.081	-3.0745	-0.7019	353.9	257.5	96.395	9.6395

- Taguchi Response Summary

Taguchi Response Summary Table for S/N Ratio-Deflection

		Best Levels	Worst Levels	Best Point	Worst Point
1	Force	200.0	150.0	150.0	150.0
2	BoardLength	114.0	126.0	114.0	126.0
3	BoardWidth	24.0	18.0	24.0	24.0
4	BoardThickness	2.0	1.5	2.0	1.5
5	ModulusOfElasticity	1250000.0	750000.0	1250000.0	750000.0
6	SpringConstantK1	1200.0	1800.0	1800.0	1800.0
7	SpringConstantK2	1200.0	1800.0	1200.0	1800.0
8	S/N Ratio (estimate)	-11.621	-15.557		
9	S/N Ratio (actual)			-12.186	-15.23
10	Experiment #			2	4

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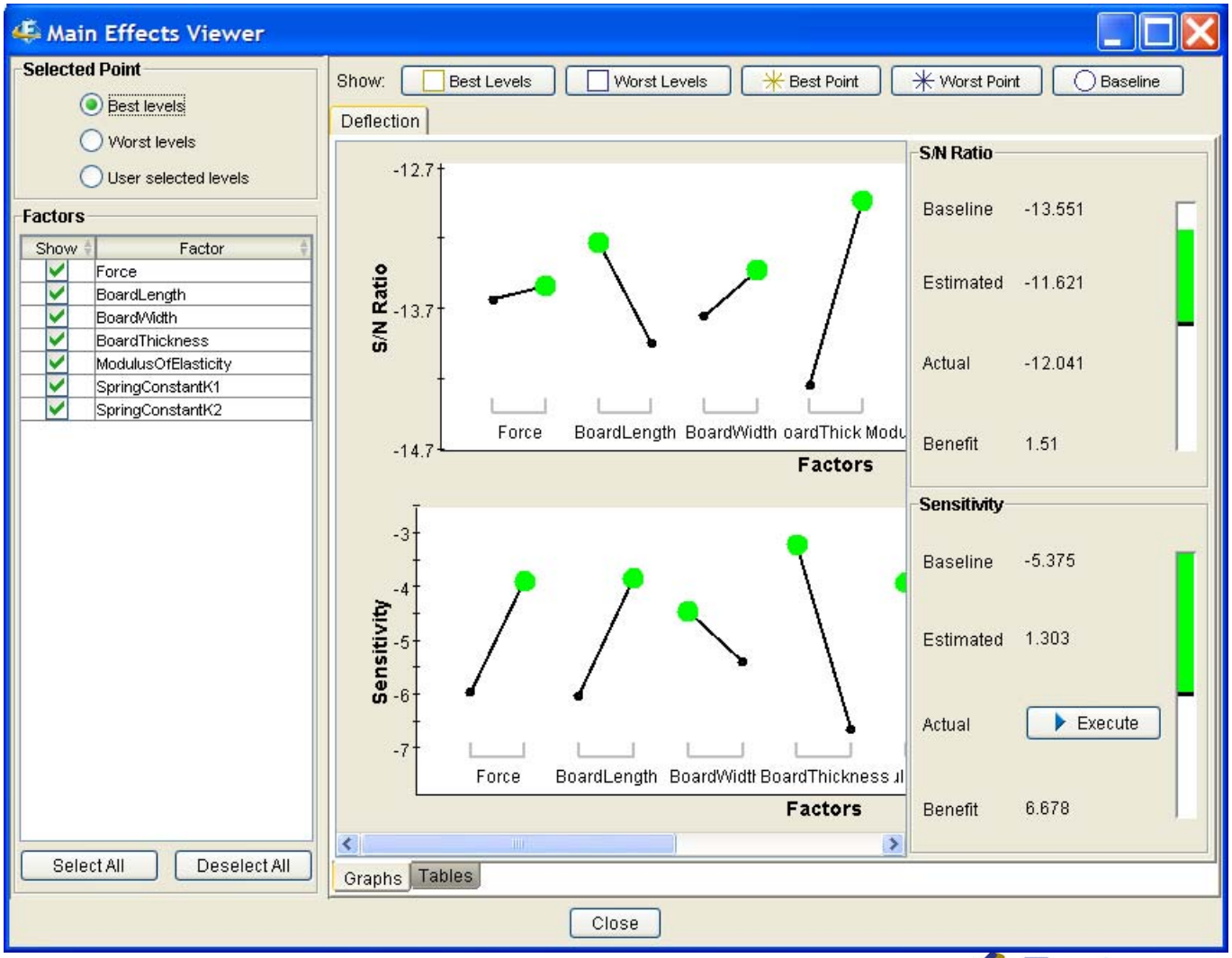
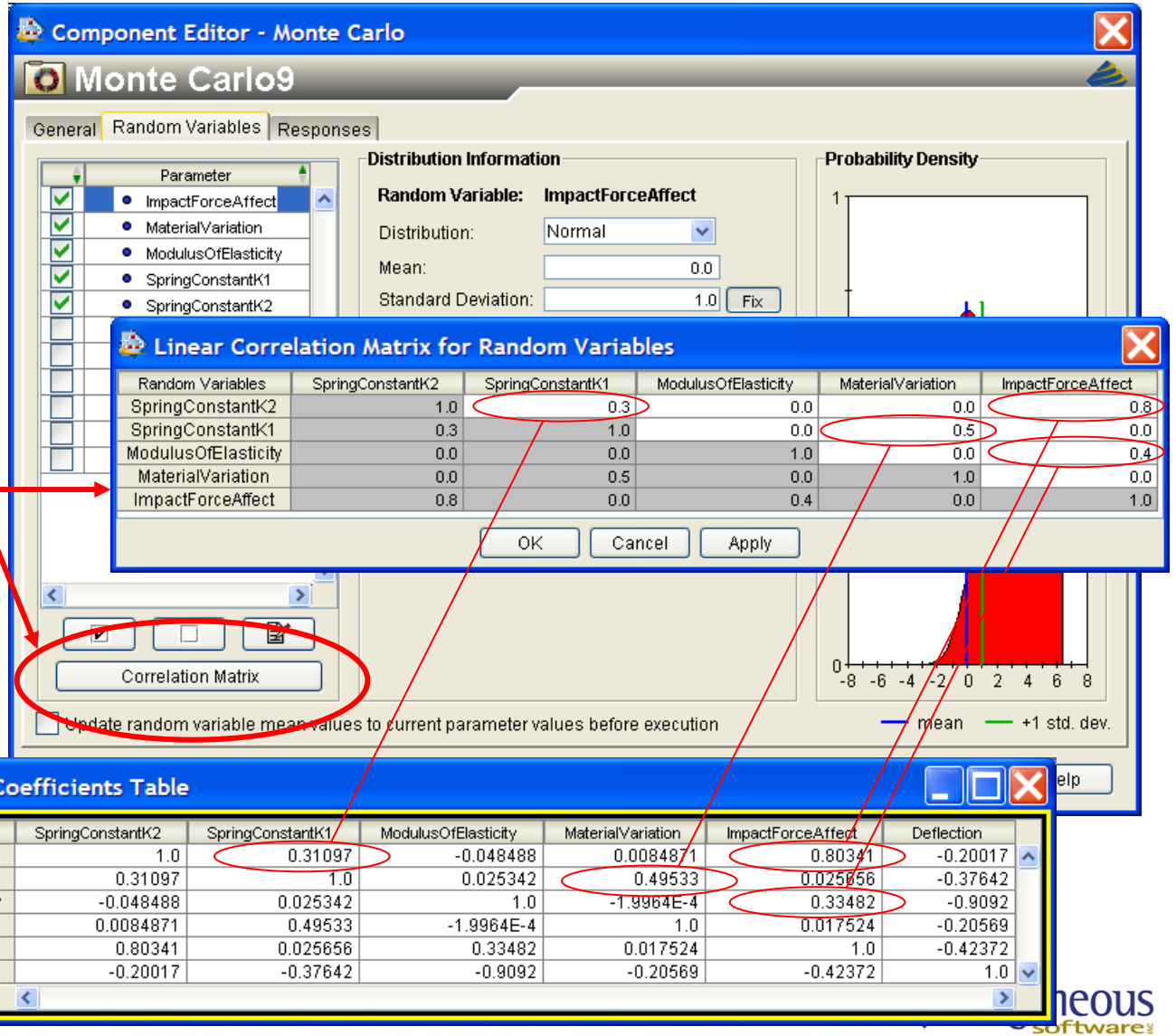
Interactive Main Effects Viewer

- Display/Select:
  - Best levels
  - Worst levels
  - Best point
  - Worst point
  - Baseline point
- Filter displayed factors
- Select individual levels, S/N and Sensitivity estimated
- Benefit over baseline of selected point
- Execute noise/signal runs to confirm estimates



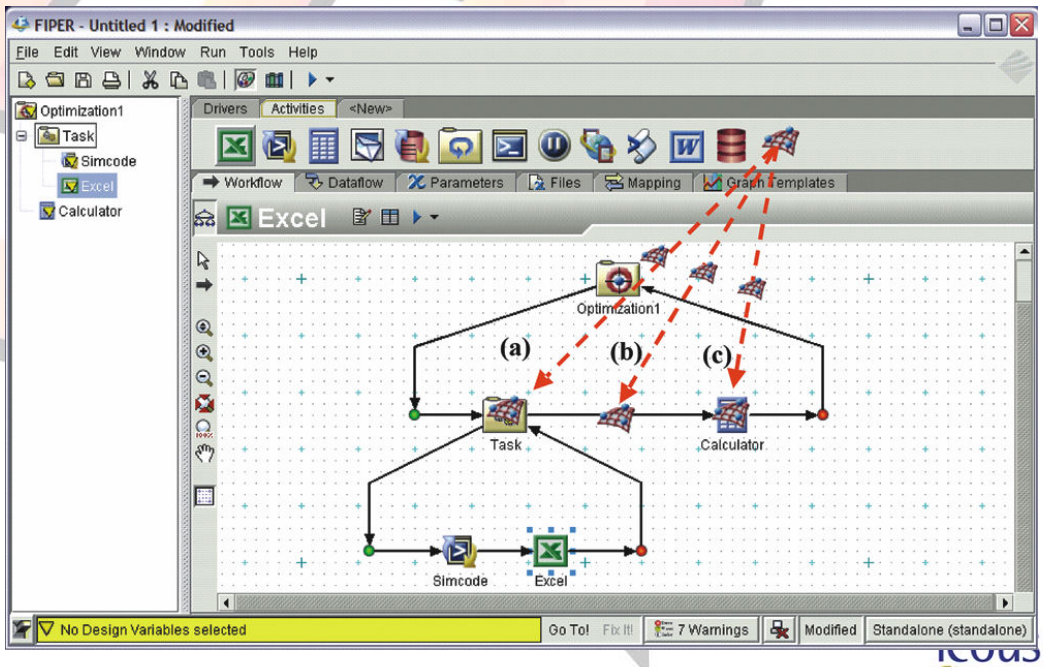
Correlated Random Variables

- Correlation Matrix button
- Correlation Matrix editor table
- Correlation results table



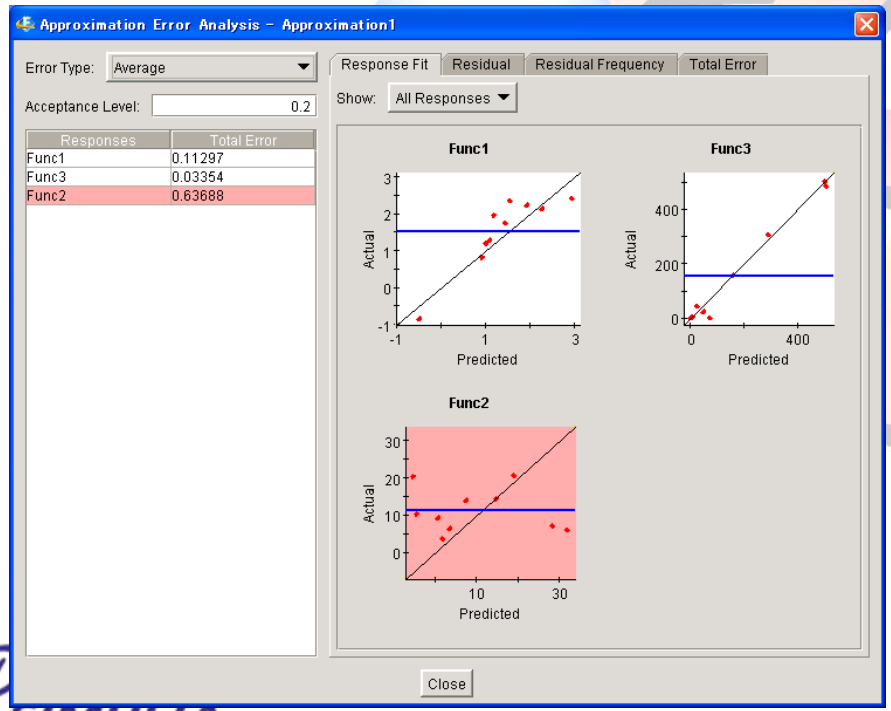
Approximation Model Component

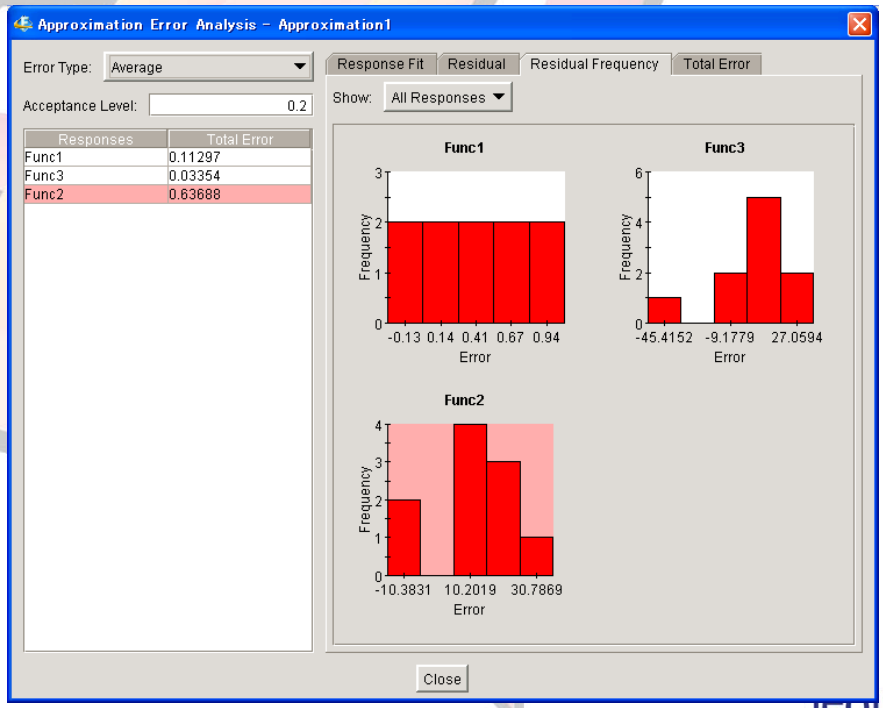
- Approximation models available in v1.0
  - Response Surface Model (RSM)
  - Radial Basis Function (RBF) neural network approximation
- Approximation model capabilities
  - Wizards for setting up the model
  - Inspection tools for evaluating model precision and margin
  - Visual Design Driver
    3D approximation model viewer for “surfing” the design space
  - Approximation models can be created as independent activities or applied to any subflow or activity component



Inspection Tool for Approximation Models

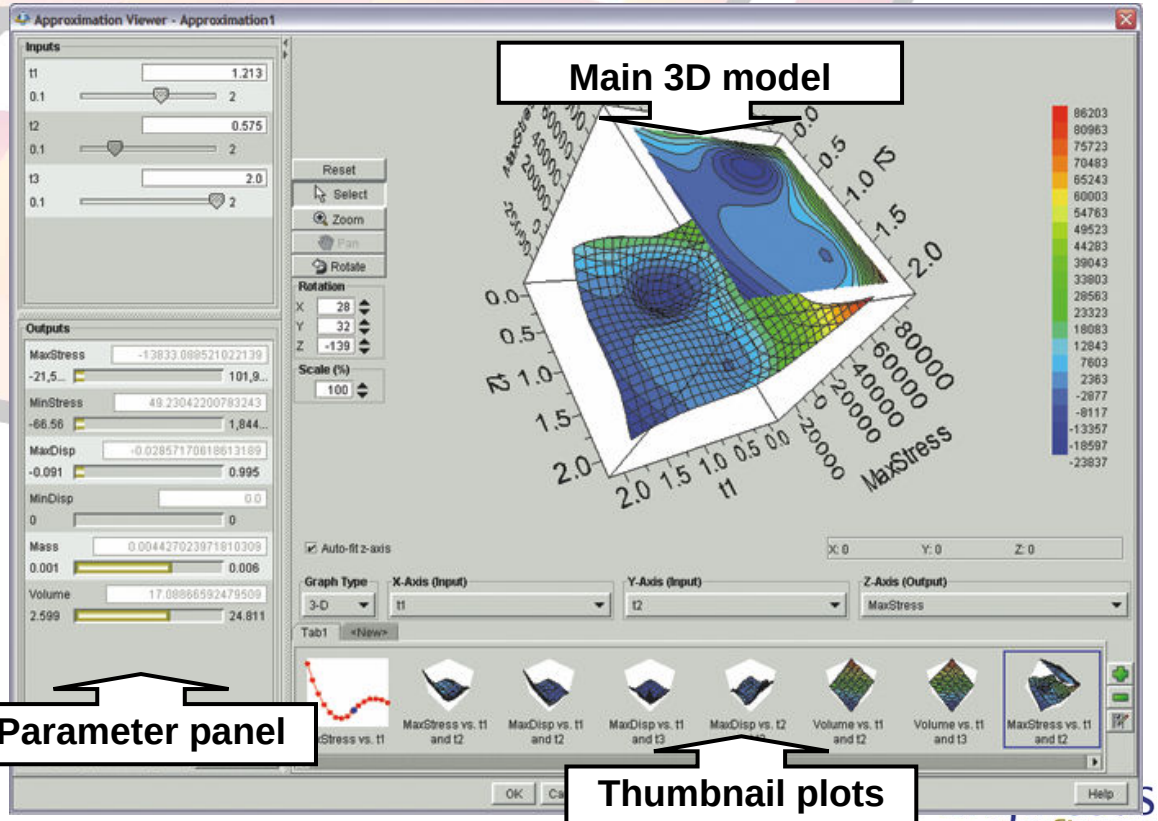
- Special GUI for approximation model inspection
  - Evaluate precision
  - Show margins between each response value
  - Show present value and predictive value





Visual Design Driver

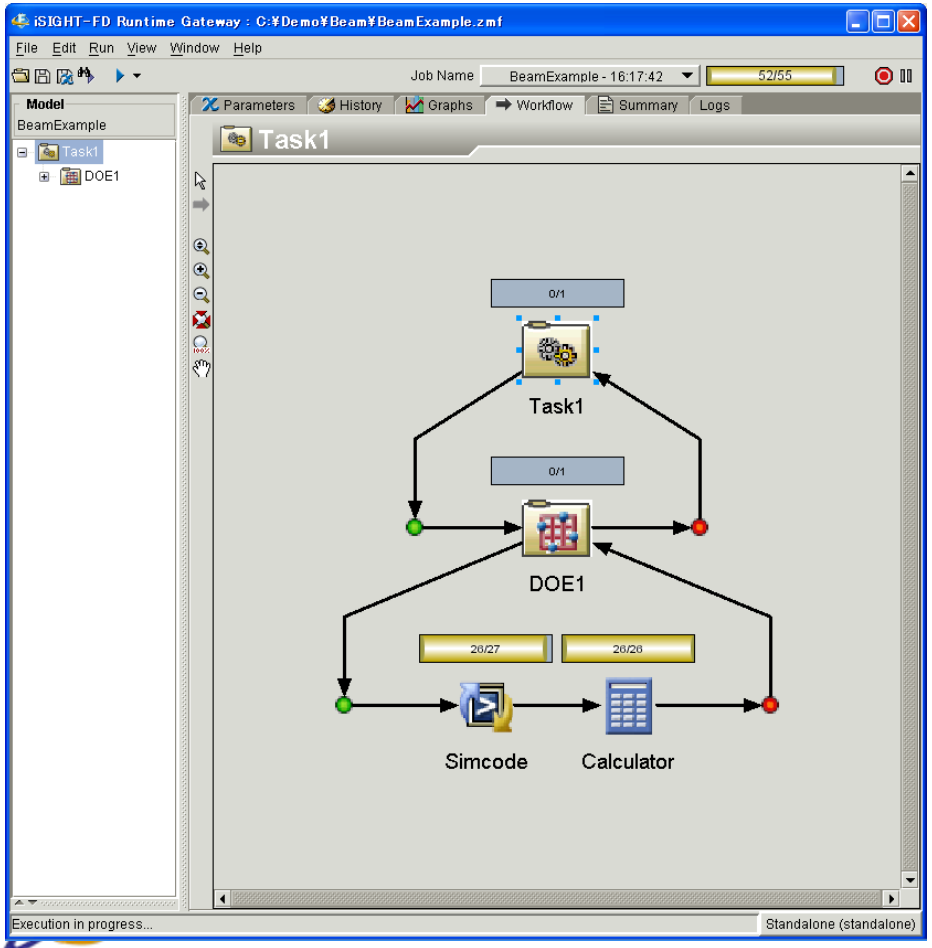
- Visualize and “surf” the approximation model design space
  - Highly interactive, multi-dimensional GUI
  - Change evaluation values by moving slide bars with mouse
  - Displays multiple thumbnail plots, any of which can be switched into the main window



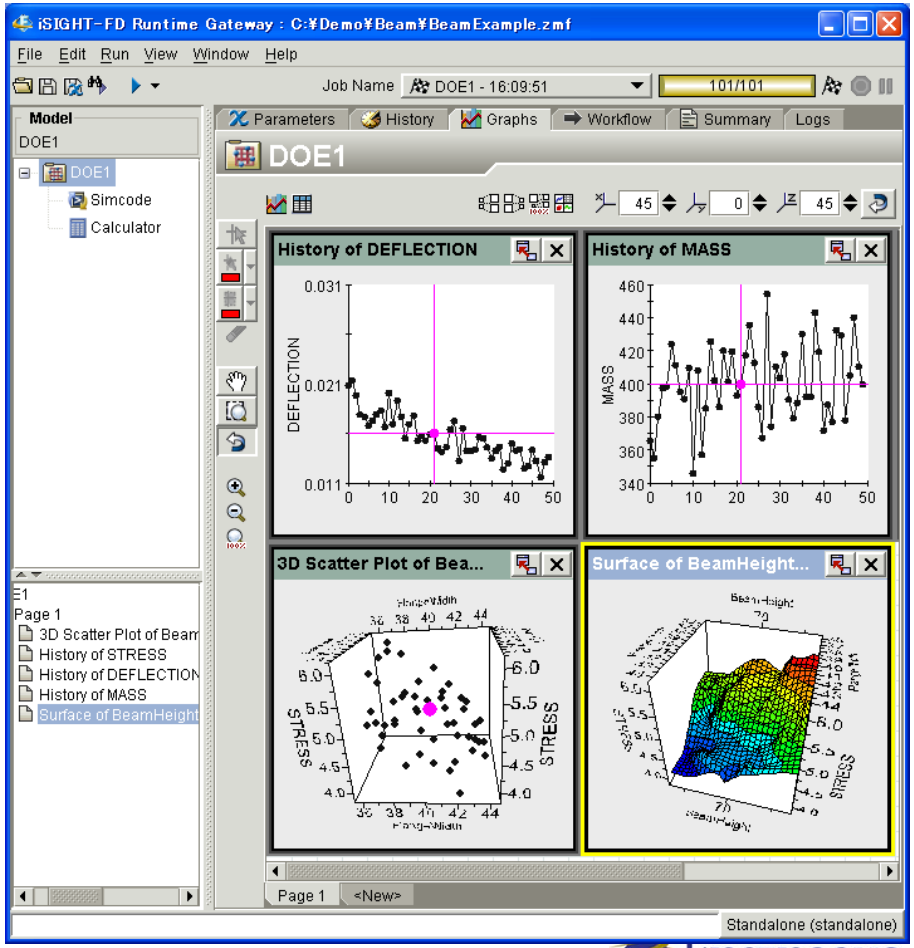
Workflow Execution
&
Post Processing

Monitoring Tools

Runtime Workflow status

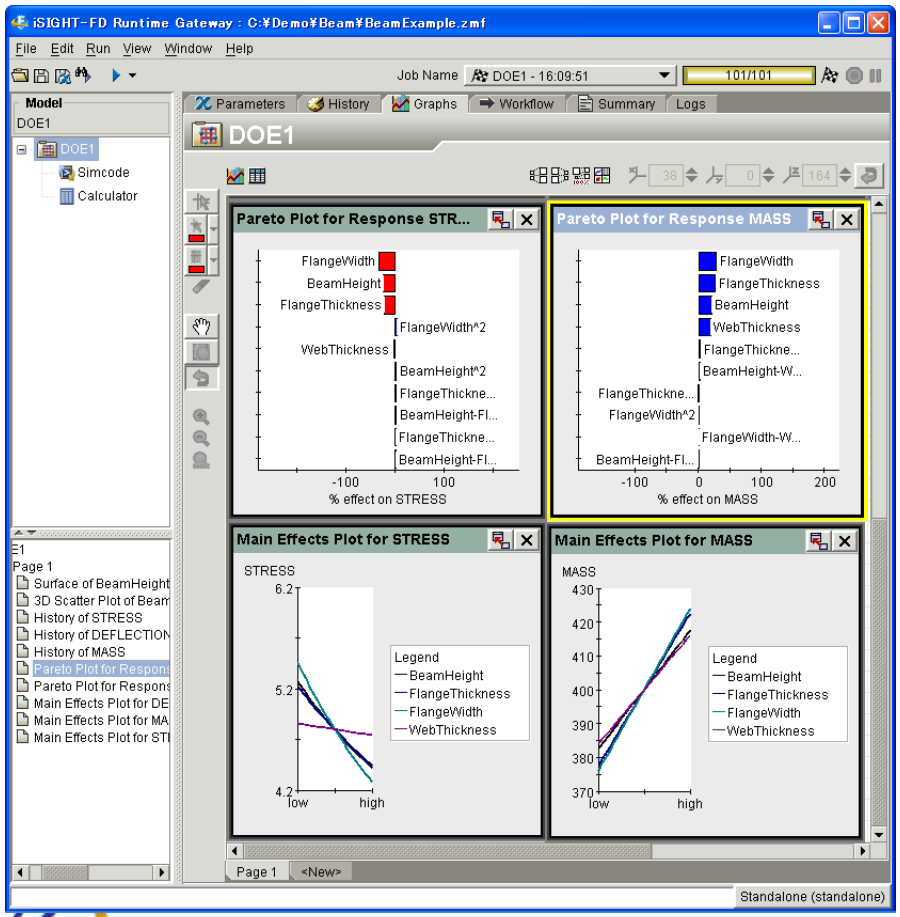


Monitoring with graphs

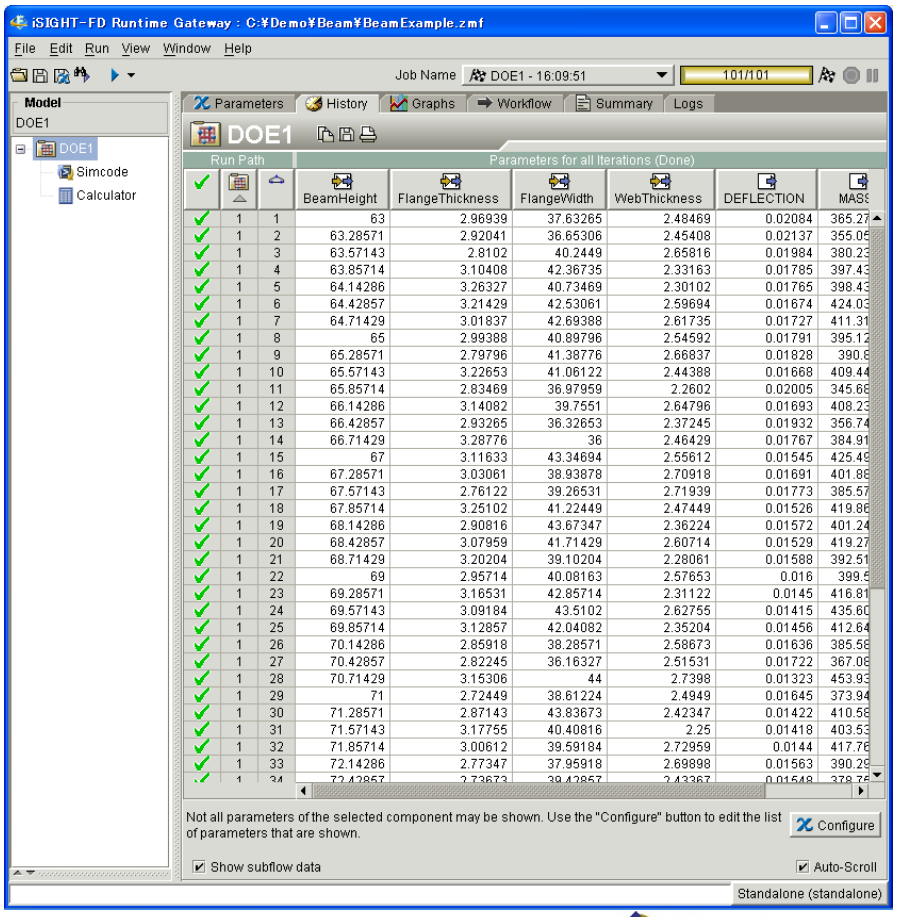


POST Processing and History Tables

Post processing for sampling results



Execution history to check values



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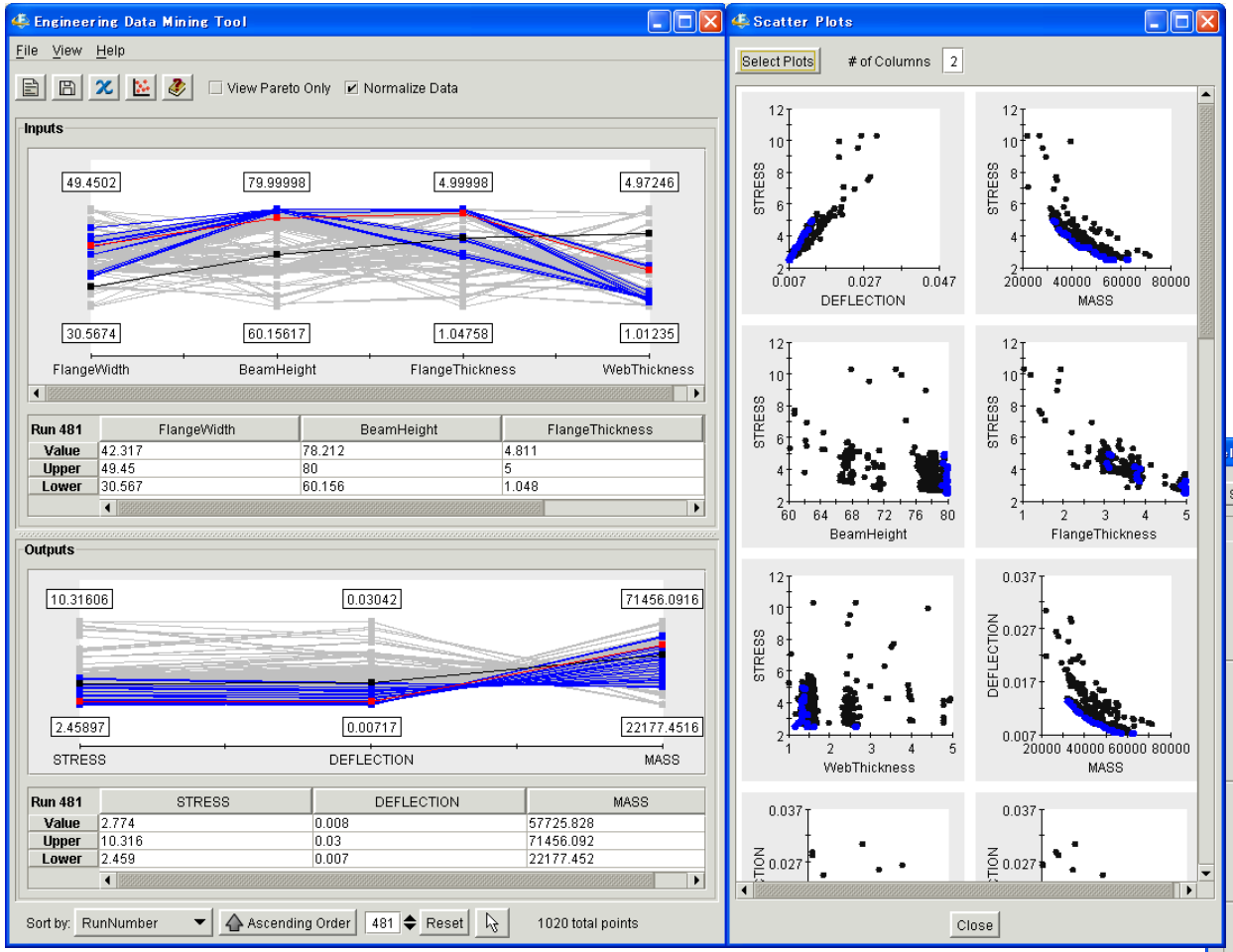
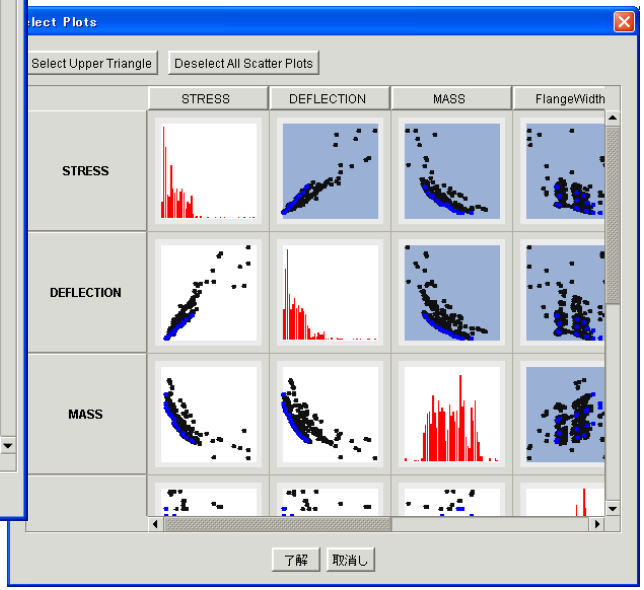
Engineering Data Mining for Post Processing



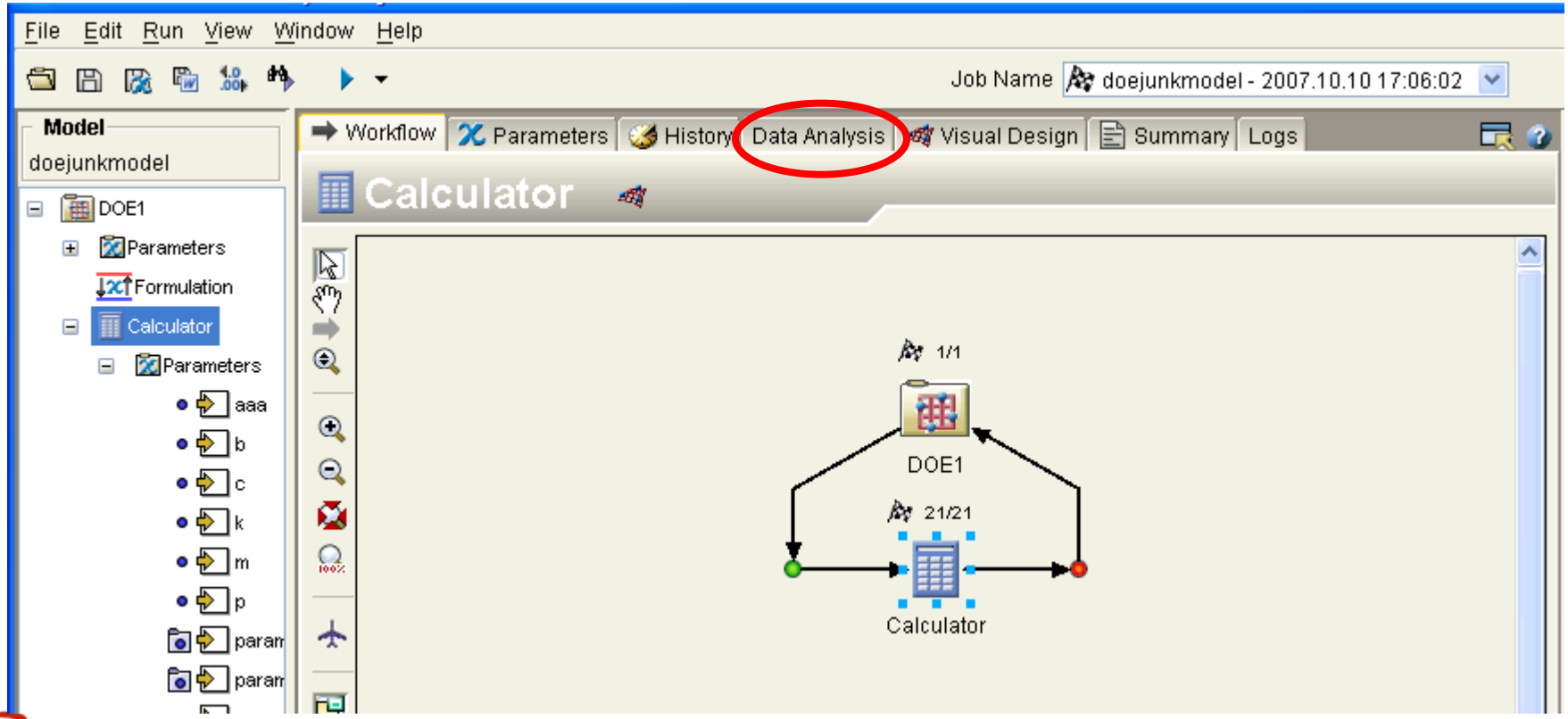


Main GUI

Scatter Plots

Data Analysis Tab

- The Runtime Gateway contains a single Data Analysis tab with a number of useful post processing tools



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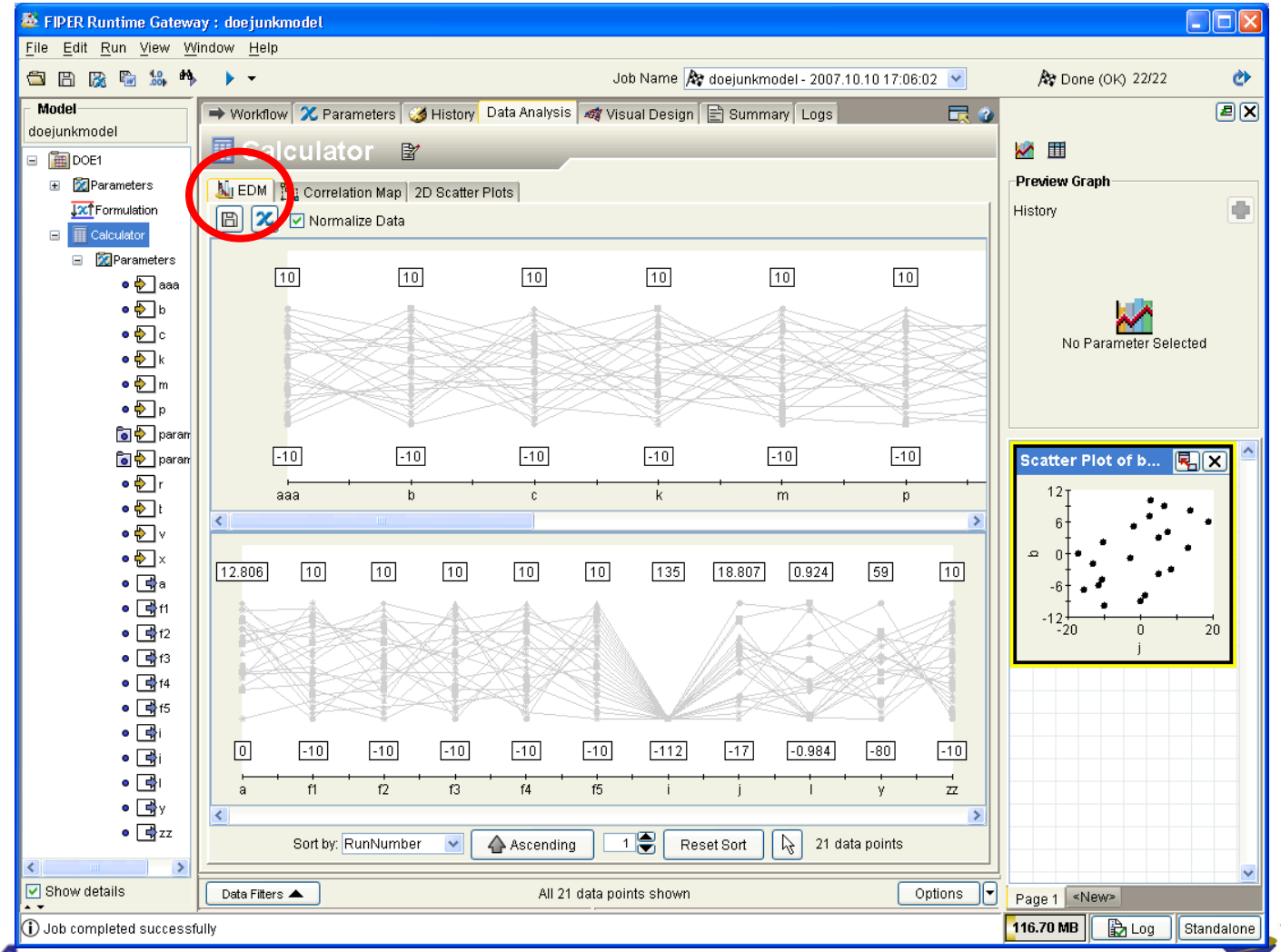
Data Analysis Tab

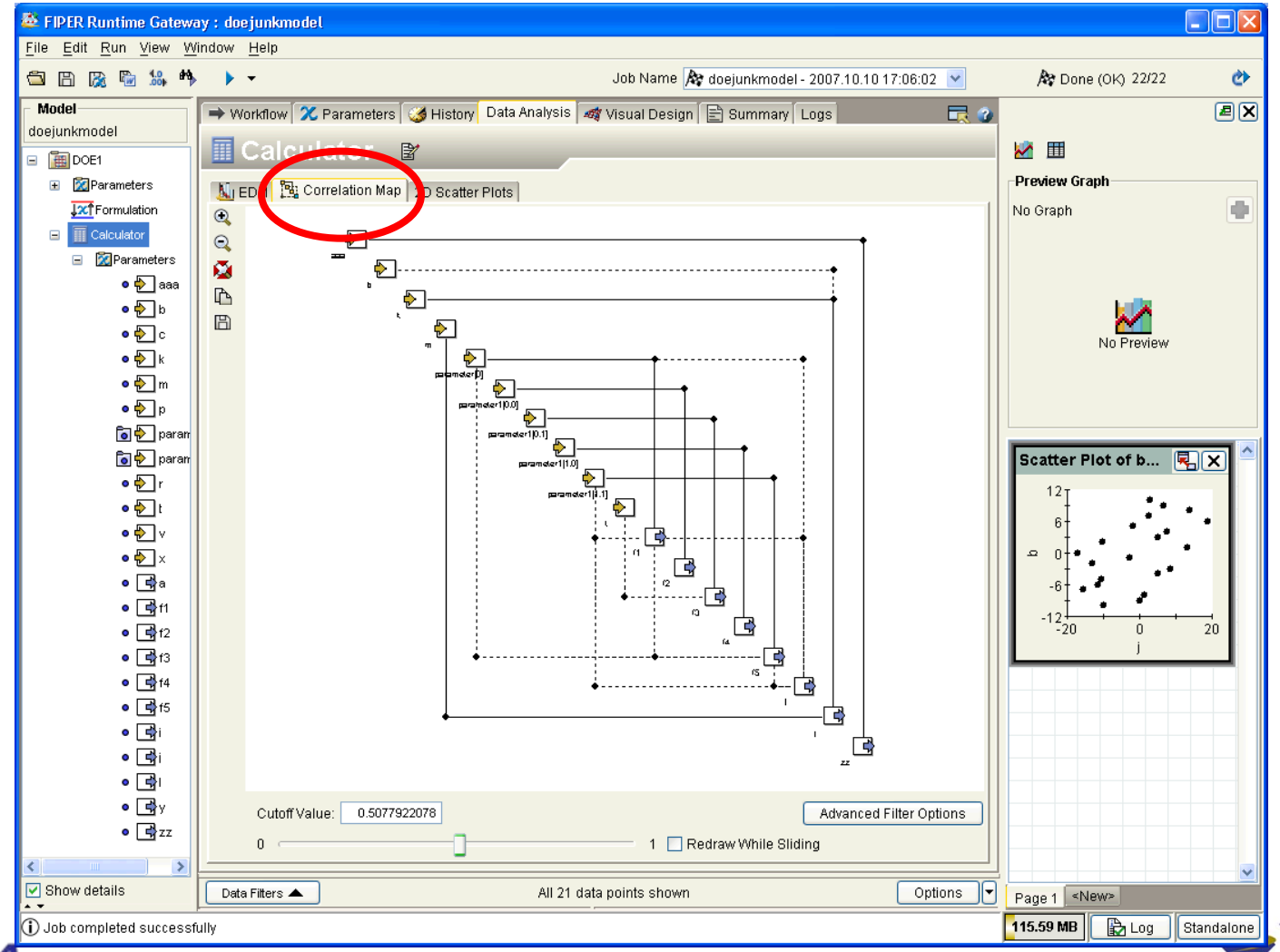
- Including EDM



53

Data Analysis Tab

- Correlation Map



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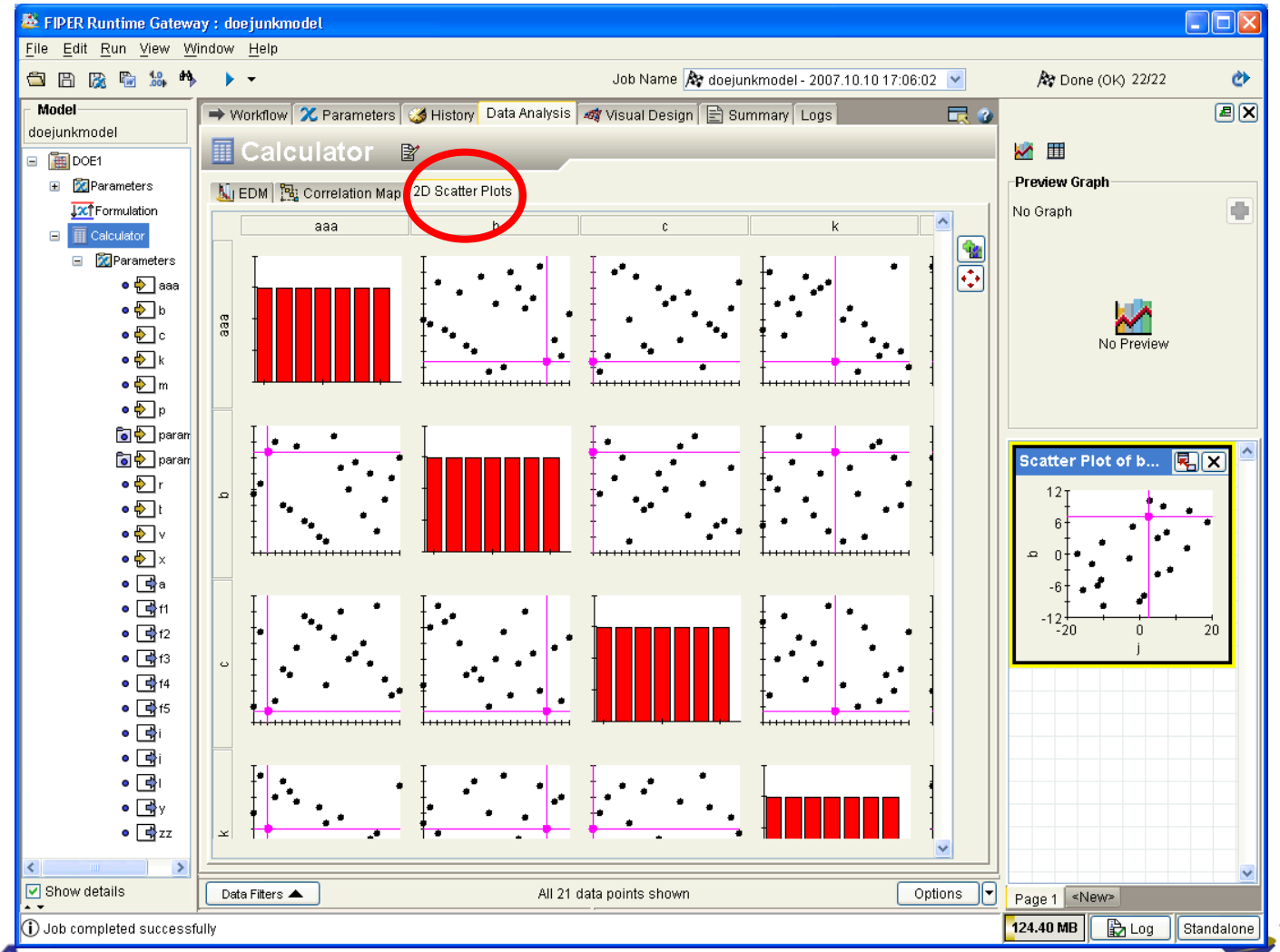
Data Analysis Tab

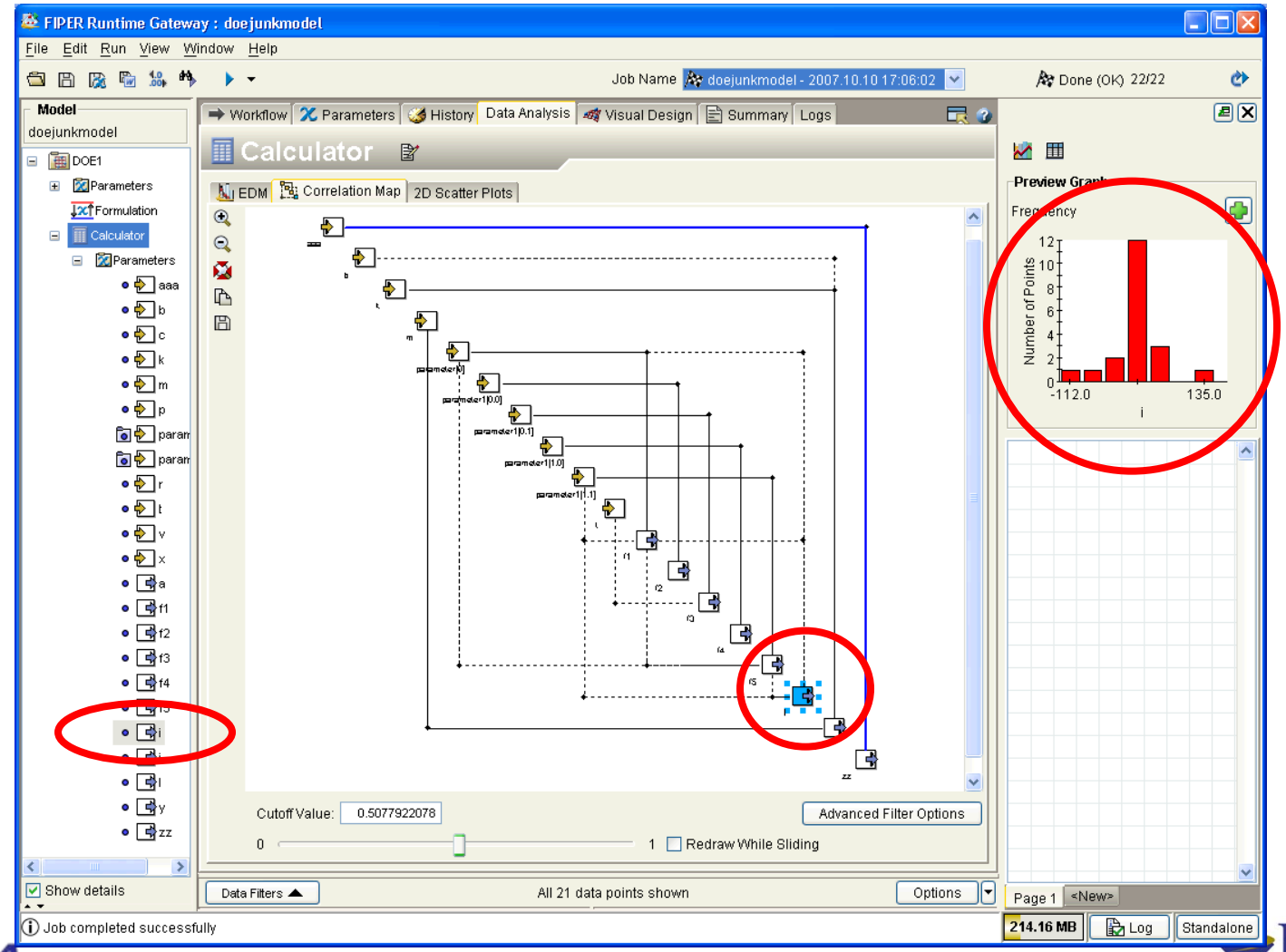
- And a Grid of 2D Scatter Plots



55

Correlation Map Tab

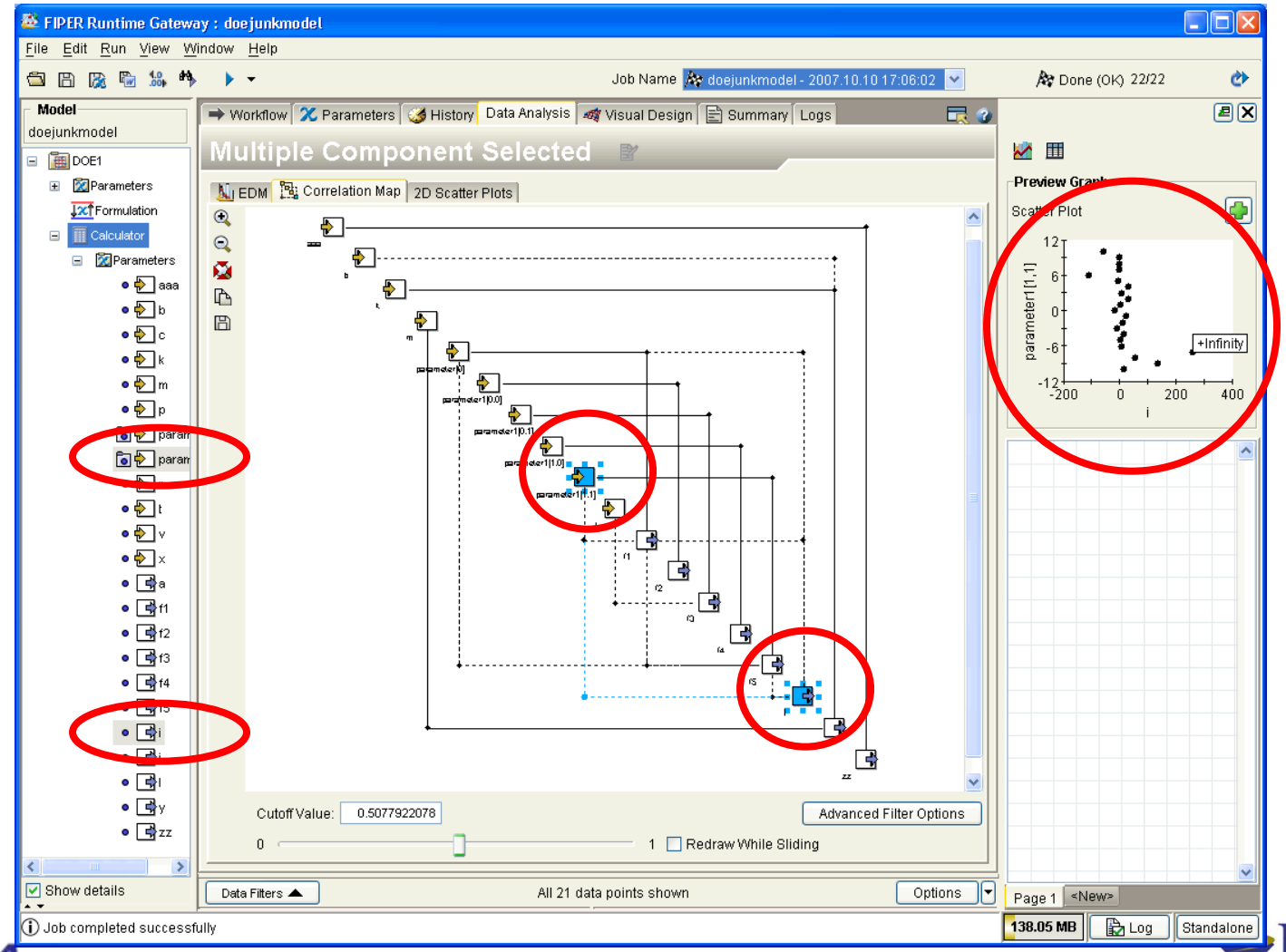
- Where selecting a parameters is synced with the rest of the Gateway



56

Correlation Map Tab

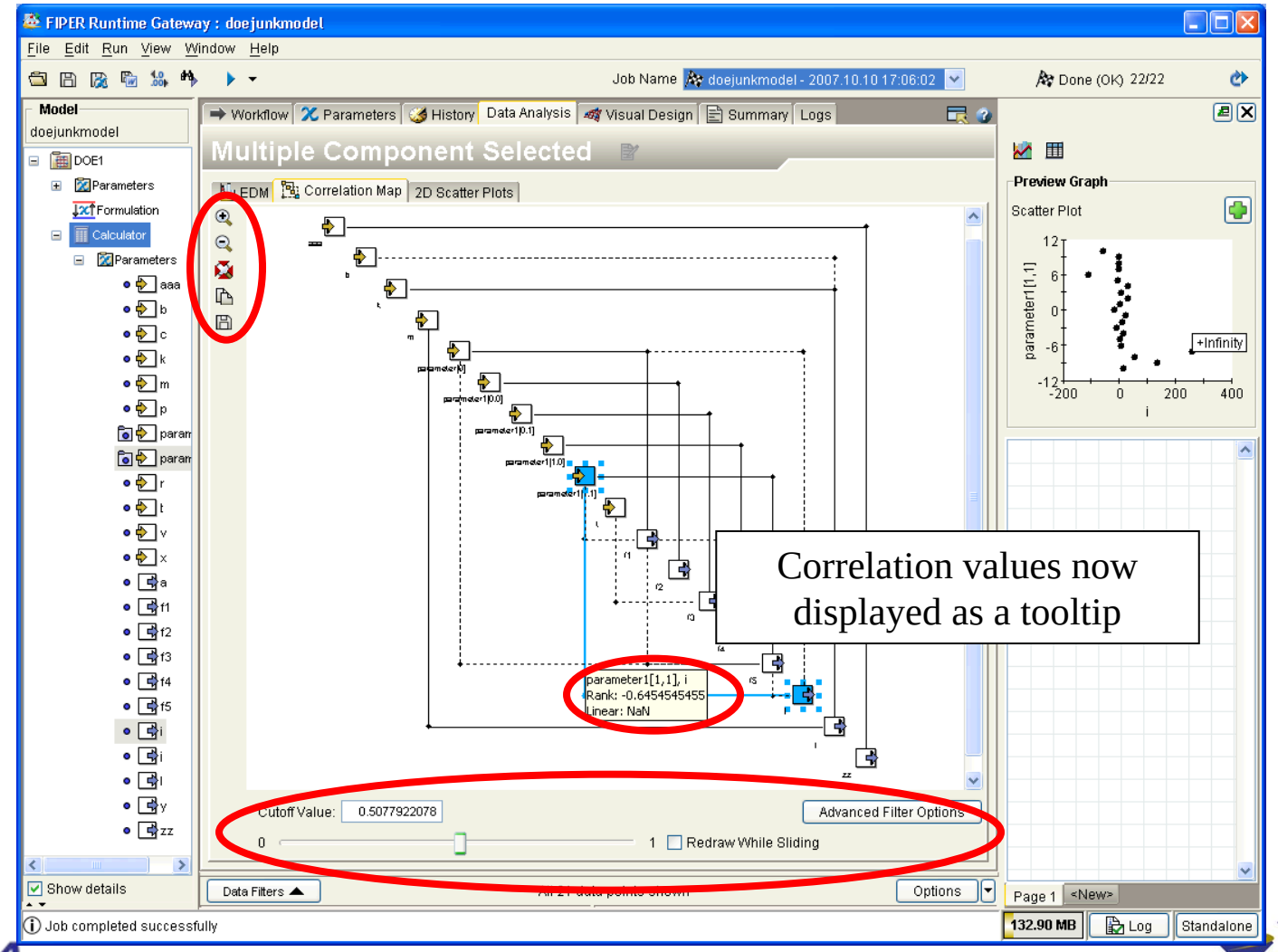
- Where selecting a parameters is synced with the rest of the Gateway



57

Correlation Map Tab

- The old functionality remains (though moved around a bit)



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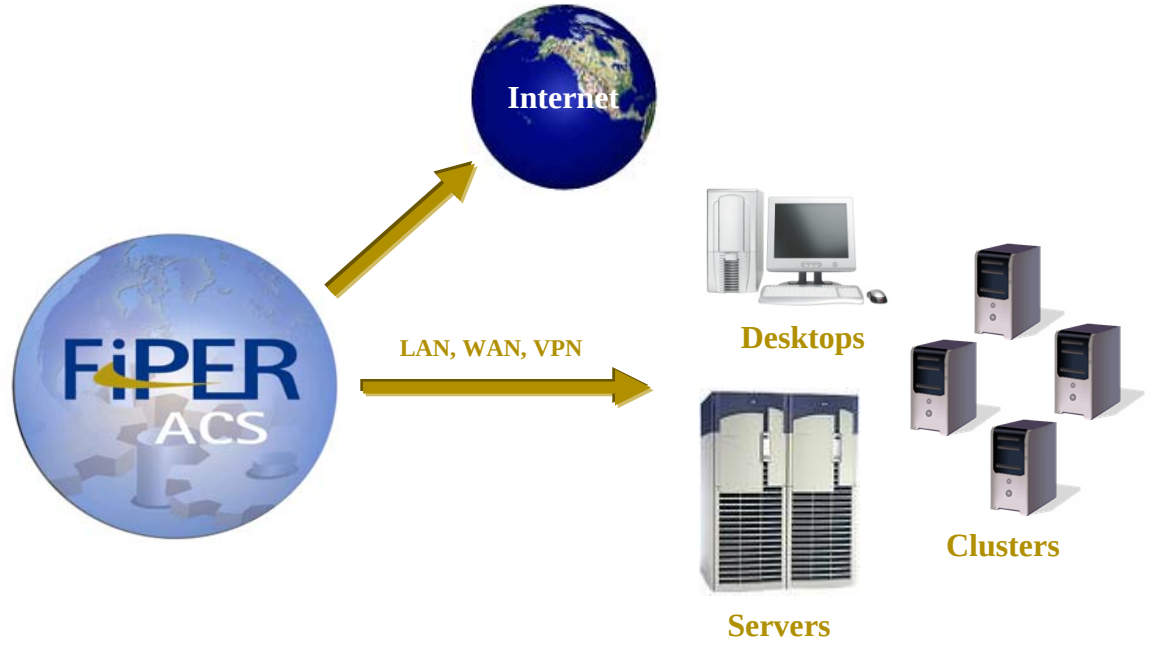
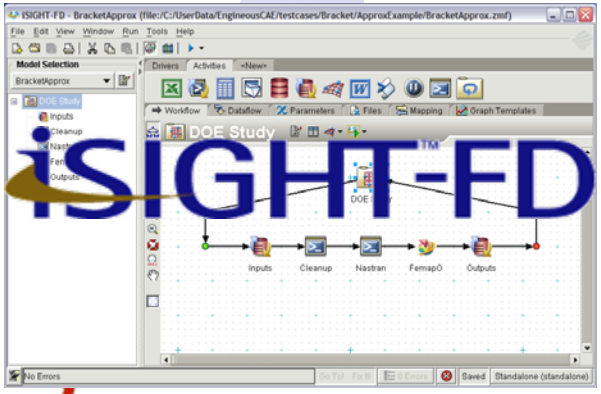
Extending Local Processes to the Enterprise

Extensible to the Enterprise

Publish Components and Workflows to FIPER



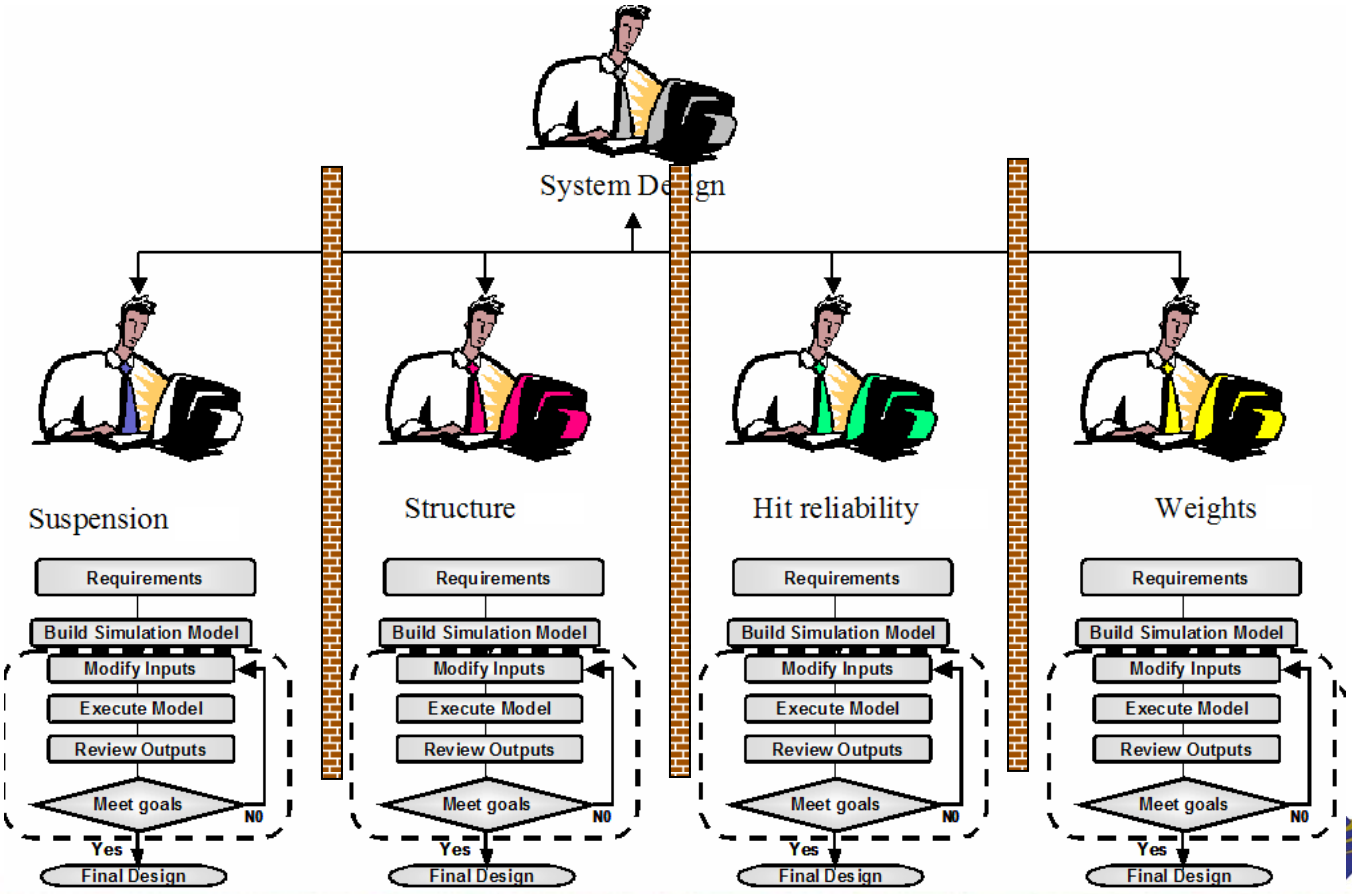


FIPER ACS (Application Control Server) Connection

- Share Components and Workflows
- Effective use of computer resources on FIPER
- Monitoring executing Workflow status on Web
- Consolidate data management using Database

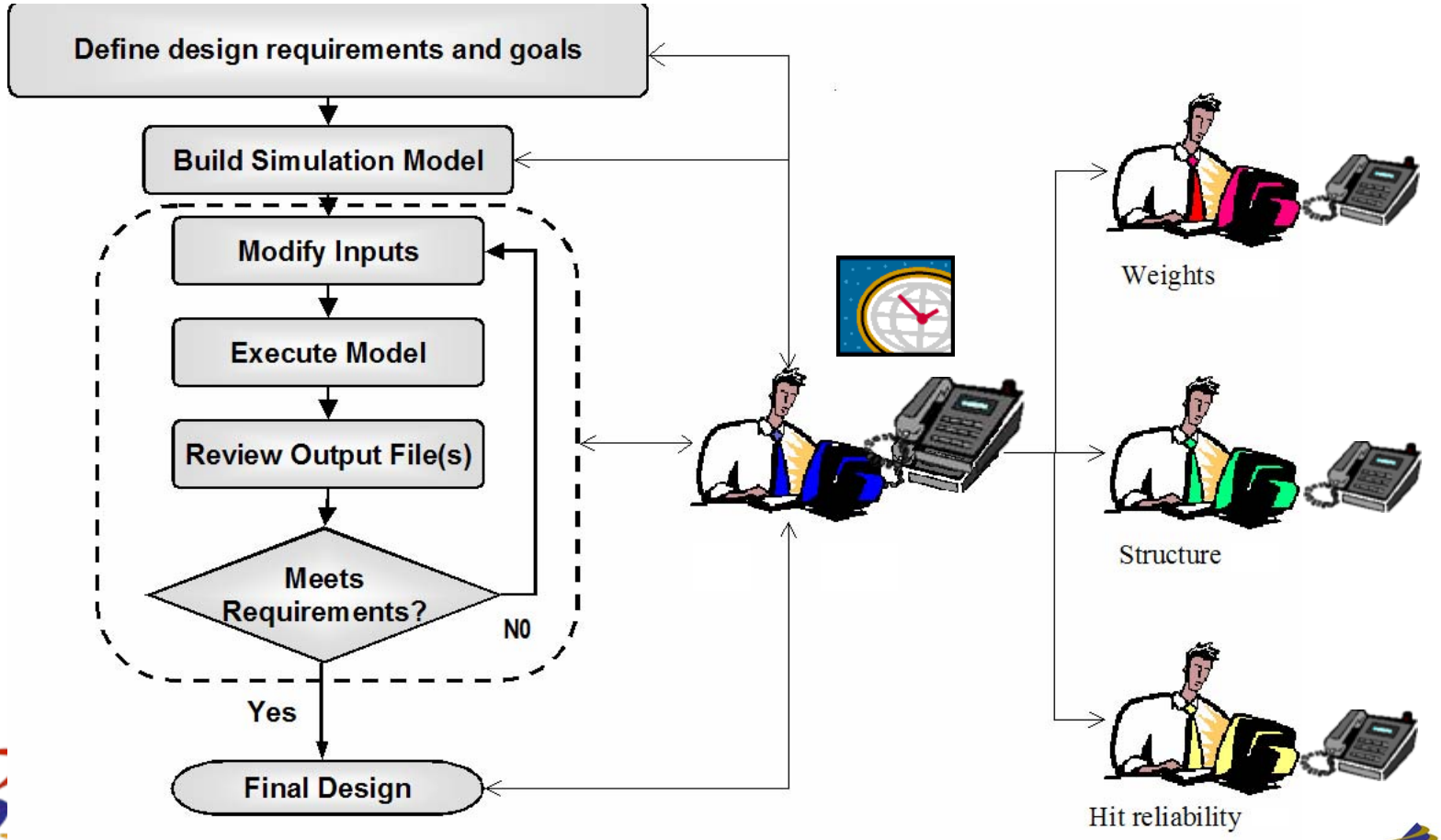
System Simulation Challenges

Simulation of systems often require multiple simulation models, significant data management, and workflow definition. This is often performed in a “stove pipe” fashion with communication in manual steps. As a result, design alternatives and important trade-offs and go un-noticed and are never communicated to the customer.



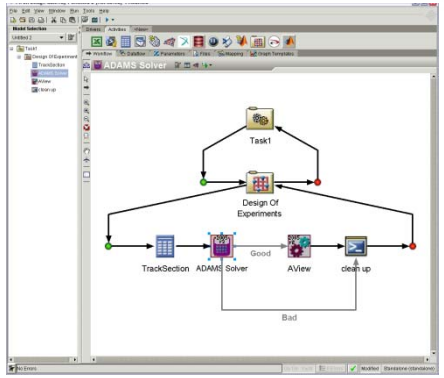
Simulation Collaboration Challenge

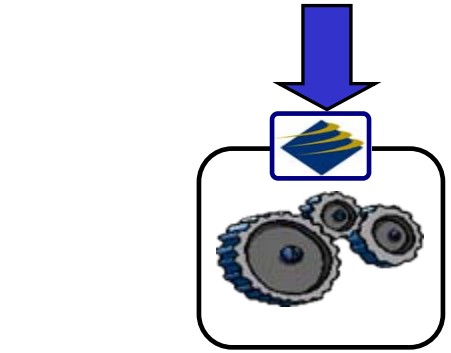
Design groups require and request simulation results from other groups. Design time is lost while waiting for response. As a result, this limits and delays options.

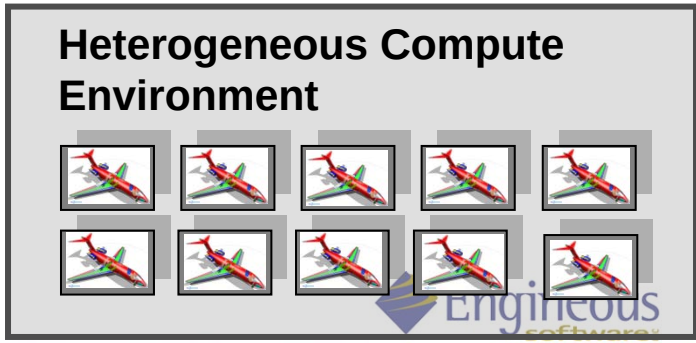


FIPER Distributed and Parallel Computing

- Leverage parallel and distributed computing for efficient multirun simulation
  - iSIGHT framework is parallel and distributed by design
  - IBM On-Demand "Grid computing" environment
  - Transparent to end-user
    - No shared file system requirements
    - Any mix of operating systems
    - Any mix of hardware platforms
    - No special configuration files or model changes
    - No limitations on structure of model
  - Open to leverage existing grid environment:
    - E.g. LSF, Globus, etc.
    - No 3rd party grid software required

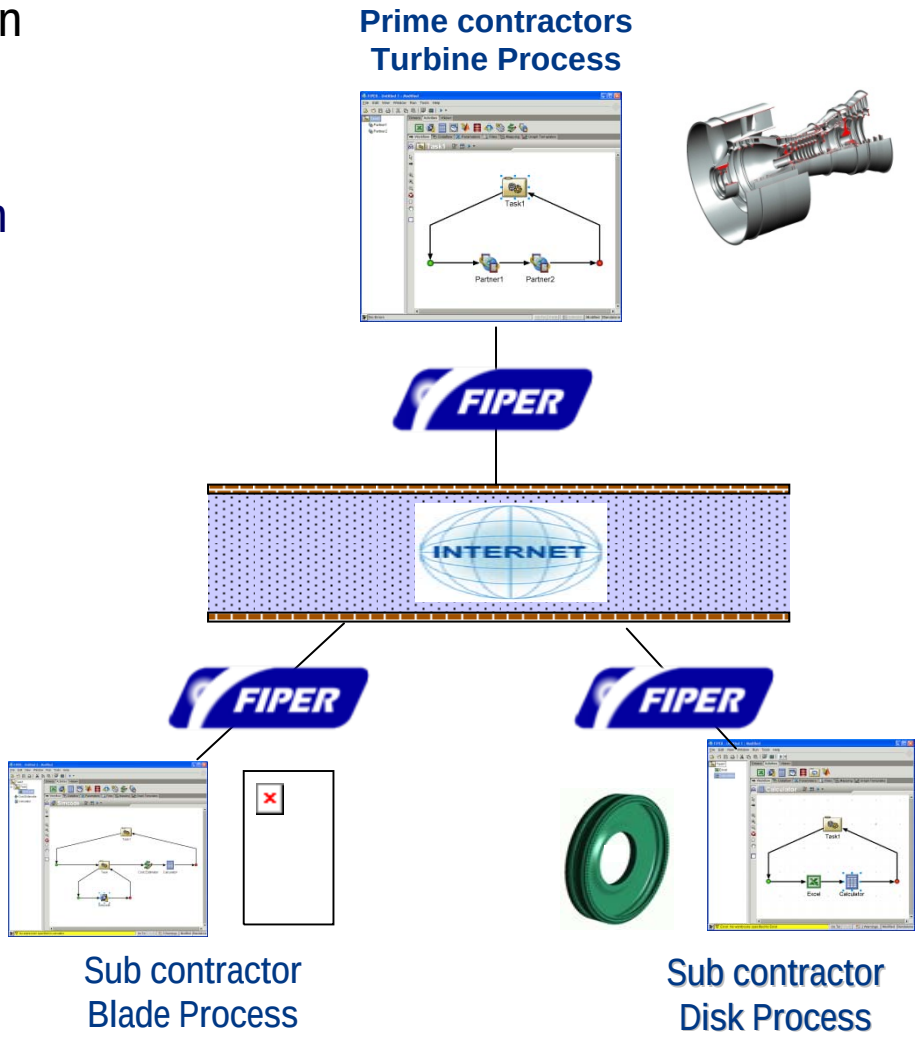






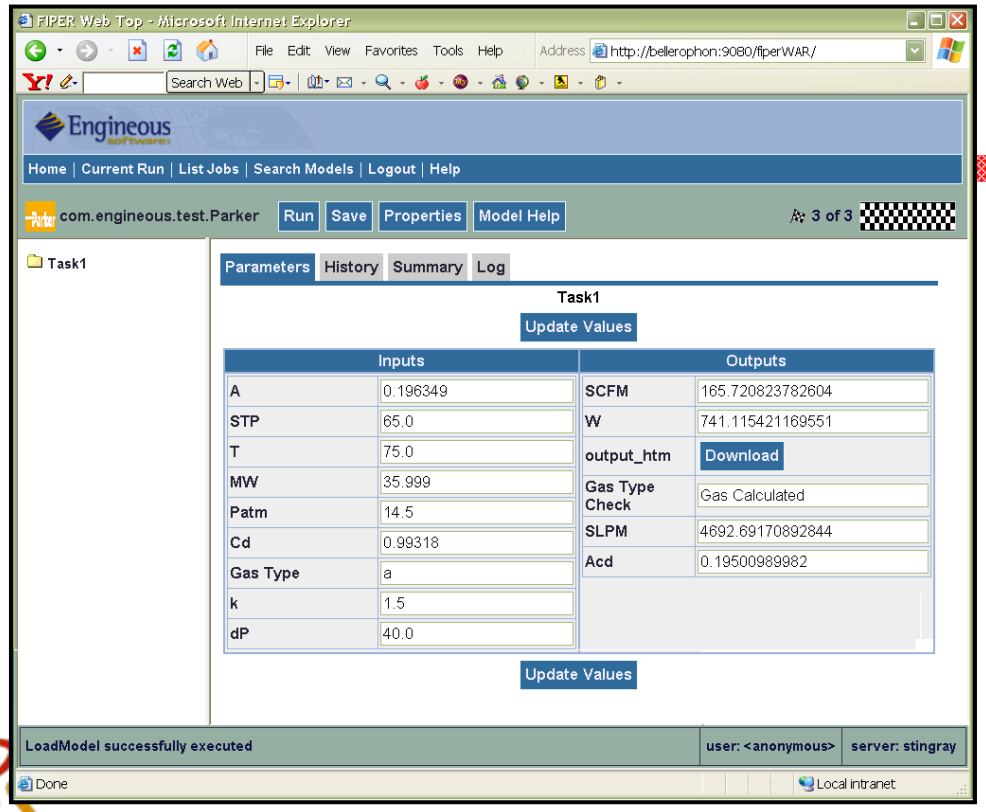
FIPER - Collaborative Design

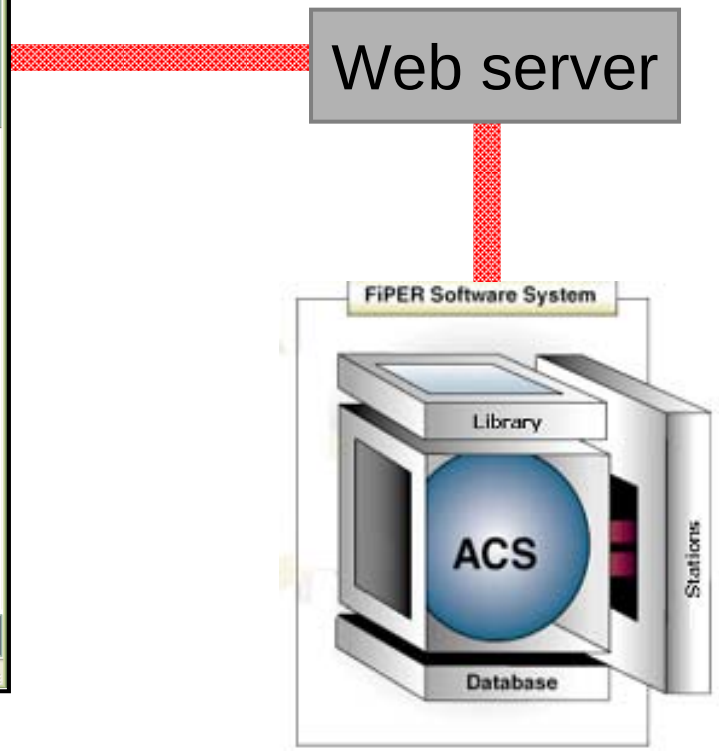
- FIPER allows knowledge sharing and design collaboration by:
  - Provides a model and tool library
  - Remote process sharing and execution
    - Incorporate other's processes in your own
    - Real-time data access
    - Protects intellectual property
    - Shares best practices
  - Securely collaborate with coworkers, vendors, or partners
    - Internally (LAN)
    - Externally (B2B – internet)



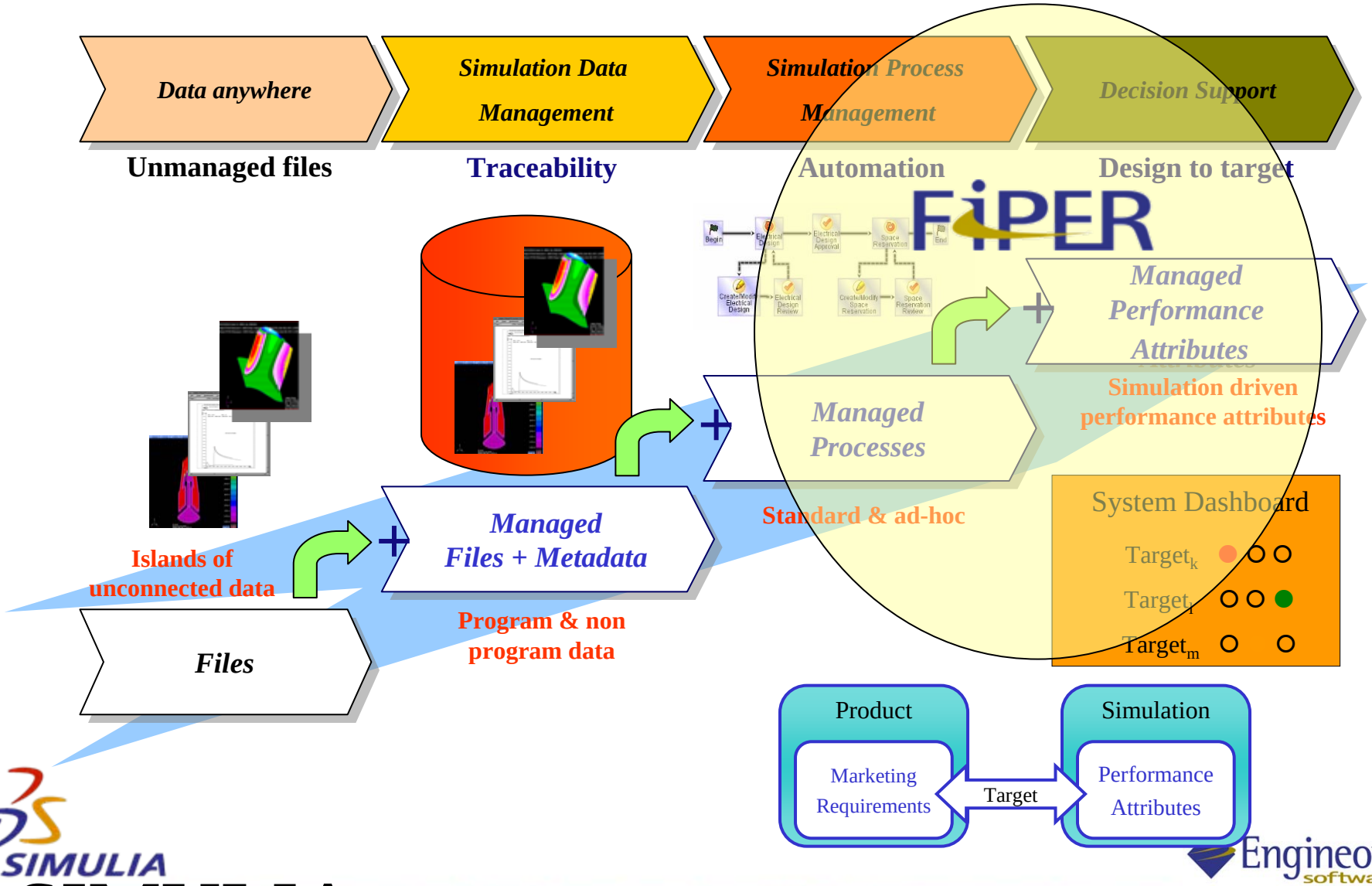
FIPER WEBTOP Client

- FIPER allows end user to access, modify, and execute models from a web client.
- FIPER allows users to run model remotely through browser





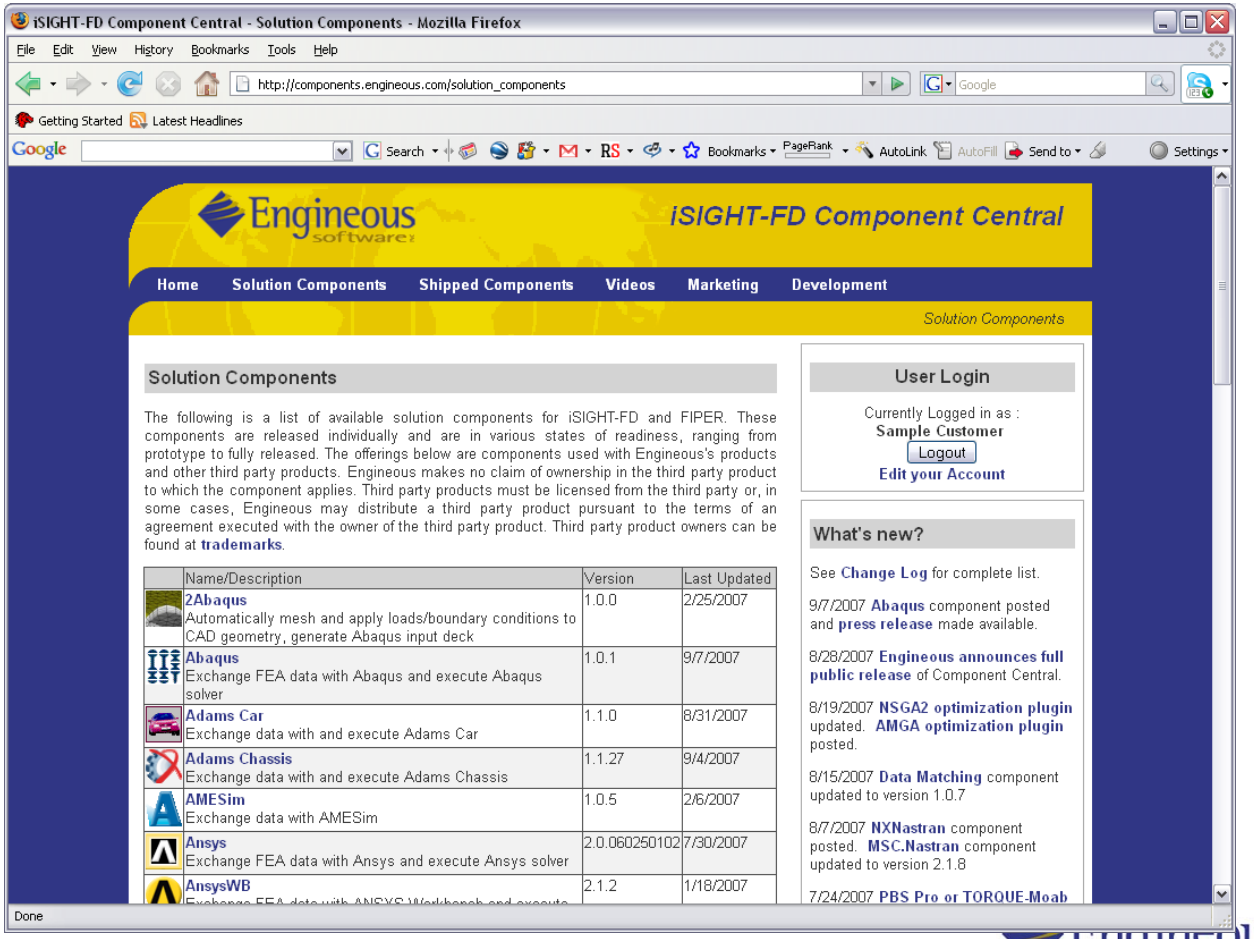
FIPER and Simulation Data Management



iSIGHT-FD Component Central

Demo Videos and the latest additions to the components suite are available at:

http://components.engineous.com



Thank you!

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