Process Integration and Design Optimization using Isight

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3DEXPERIENCE

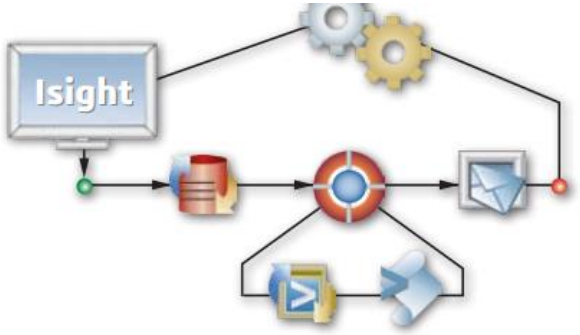
Process Integration and Design Optimization (PIDO) using Isight

- Introduction to Isight and PIDO
- Process integration using Isight
- Simple PIDO Example
- Execution options

  Desktop and SIMULIA Execution Engine

Introduction to Isight

- **Isight is used for :**
  - Controlling software processes
  - Understanding design options
  - Balancing design tradeoffs
  - Investigate design sensitivities.



- **PIDO**
  - **Process Integration:**

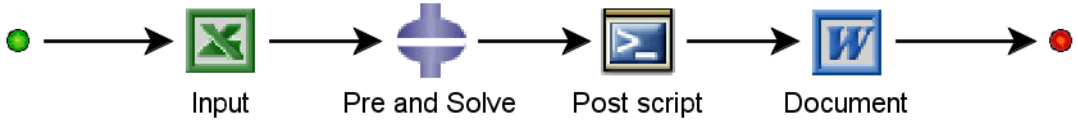
Isight is used for controlling other software such as FEA/CFD codes, mathematical codes, scripts etc. which are used in a simulation workflow, we call this : Process Integration

  - **Design Optimization:**

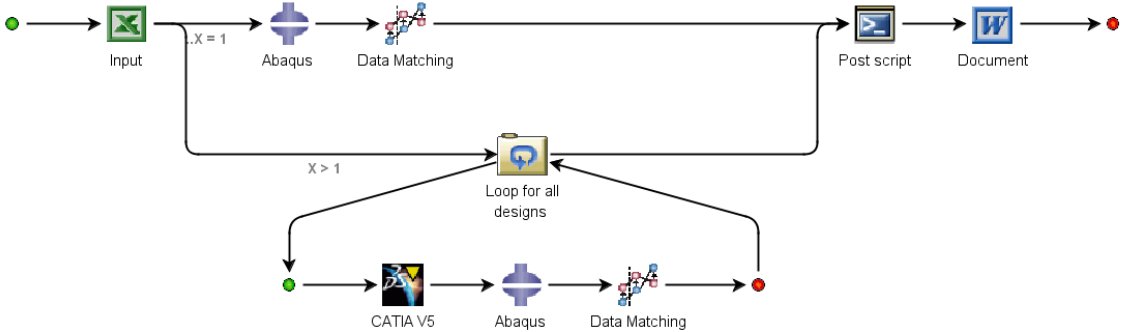
An Integrated Processes in Isight can be controlled by Design Exploration drivers, we call these controllers : Design Optimization

PI : Process Integration

- Processes/Software workflows

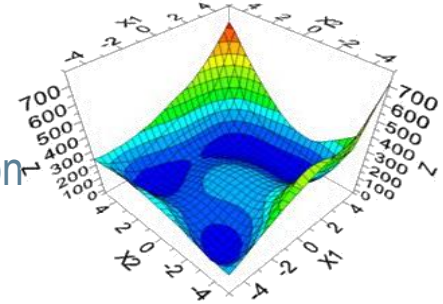


- Processes can be more or less complicated, conditional flows, sub flows, etc

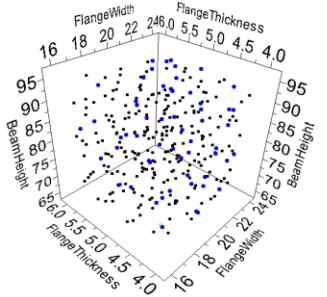


DO : The Optimization toolbox in Isight

- **Parametric Optimization** in it's simplest form, is solving problems by seeking the minimum (or maximum) of a function by systematically choosing the values of variables. Isight have numerous built in optimization algorithms.



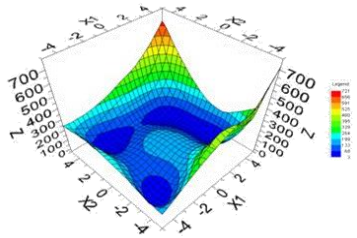
- **Design of Experiments** is discovery and navigation of the design space by varying the input parameters by different methods.
  It's design learning, how inputs give response on outputs.
  Design of Experiments is for many applications searching for more optimal products and systems, with a limited number of test samples



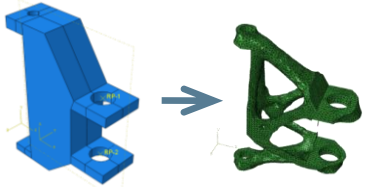
  - **Isight also includes** many other techniques for Design Optimization
    - Hybrid Techniques, Monte Carlo, Six Sigma, Taguchi, etc…

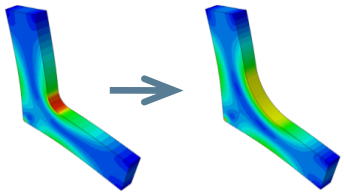
Product differentiation of Isight and Tosca Optimization

- **Isight - Parametric Optimization**
  - **Mathematical optimization,** which in its simplest case is solving problems by seeking the minimum (or maximum) of a function by systematically choosing the values of variables used as parameters.



- **Tosca - Non-Parametric Optimization**
  - **Topology optimization** is a mathematical approach that optimizes material layout within a given design space.
  - **Shape optimization,** the typical problem is to find the shape which is optimal in that it minimizes an objective function (stress or strain).



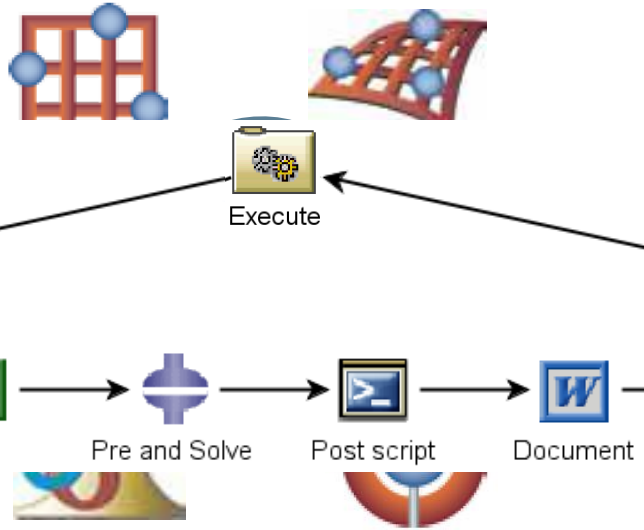


PIDO : Process Integration and Design Optimization

- Processes can be controlled by Single execution or Loop drivers and also DO

Design of Experiment
- Central Composite
- Orthogonal Array
- Latin Hypercube
- Full Factorial
- Parameter Stud
- Database
- Rapid Coupling
- Optimal LHC

Quality Engineering
- Monte Carlo
- Taguchi Robust
- Dynamic Taguchi
- Reliability Optimization
- Six Sigma Robust Design
  - Robust Analysis
  - Robust Optimization



Approximation models
- Taylor series
- Response Surface
- Stepwise RSM
- RBF NN

timization
- Rule-based
- Exploratory
- Gradient-based
- Mixed Variable
- Pointer
- Multi Objective GA
- User-supplied

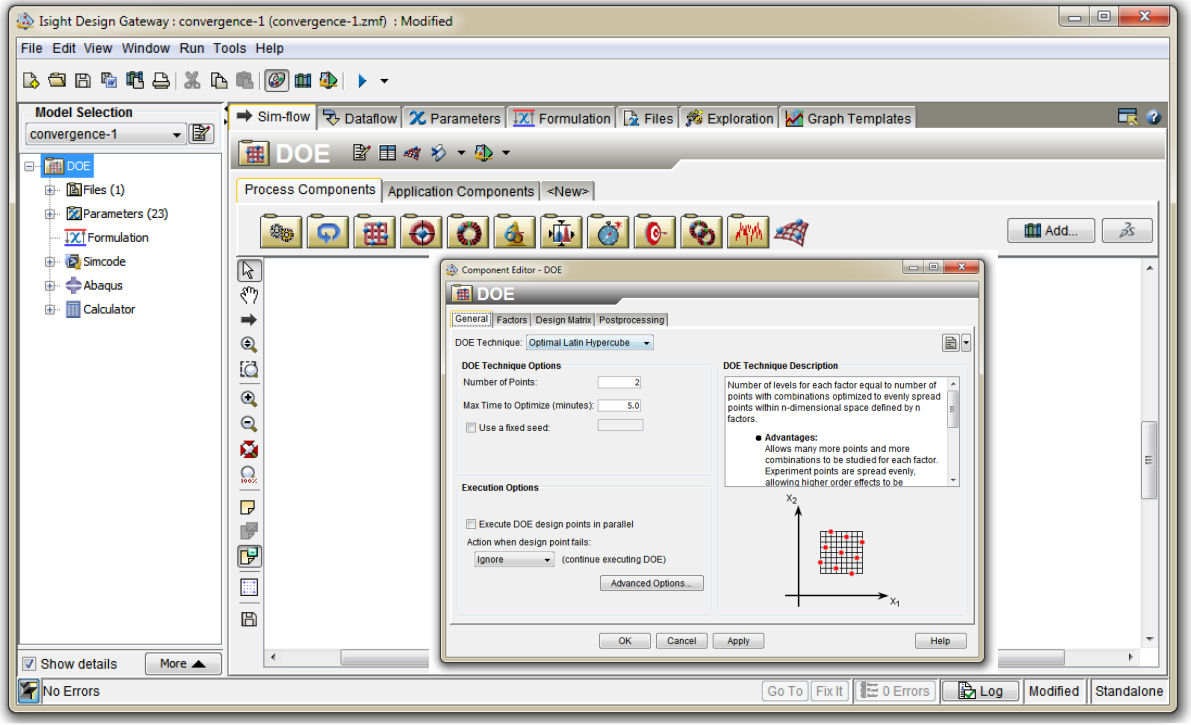
Processes in Isight, Design Gateway the Process builder

Isight Process Integration builder :

- Driver component based
- Activity component workflow
- Drag and Drop environment

Visual Interfaces, GUI's

- Processes
- Parameters and files
- Components



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Processes in Isight, Components

Activity Components connect applications to the Workflow

Generic Command Execution

	OS Command
	Simcode
	Script
	COM

File Parsers / Data Exchange

	Data Exchanger
	Database
	XML Parser
	Fast File Parser
	iSIGHT File Parser

Utilities

	Calculator
	Data Matching
	Approximation
	Mail
	Pause
	Reference

Processes in Isight, Components

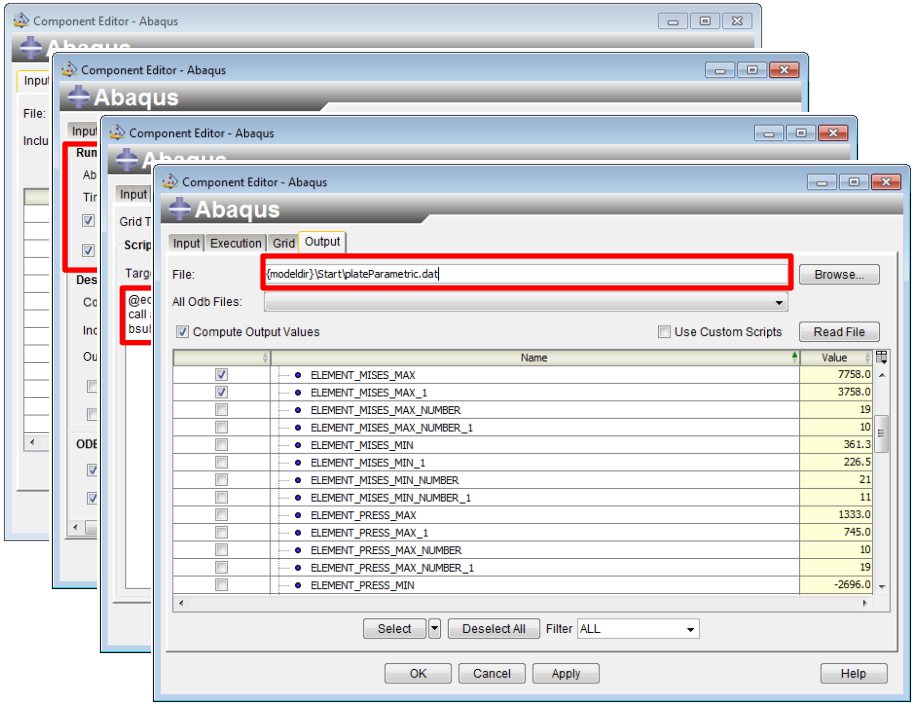
Activity Components connect applications to the Workflow

Commercial Tools

	Abaqus		Dymola		Mathcad		NXNastran
	Adams Car		Excel		Matlab		PAMCRASH
	Adams Chassis		Femap		MSC.Adams		Pro/E
	ANSA		GT-POWER		MSC.Nastran		SolidWorks
	ANSYS		iSIGHT		MSC.Patran		STAR-CCM+
	ANSYS Workbench		LS-DYNA		NEiNastran		TurboOpt
	CATIA V5		MADYMO		NX		Word

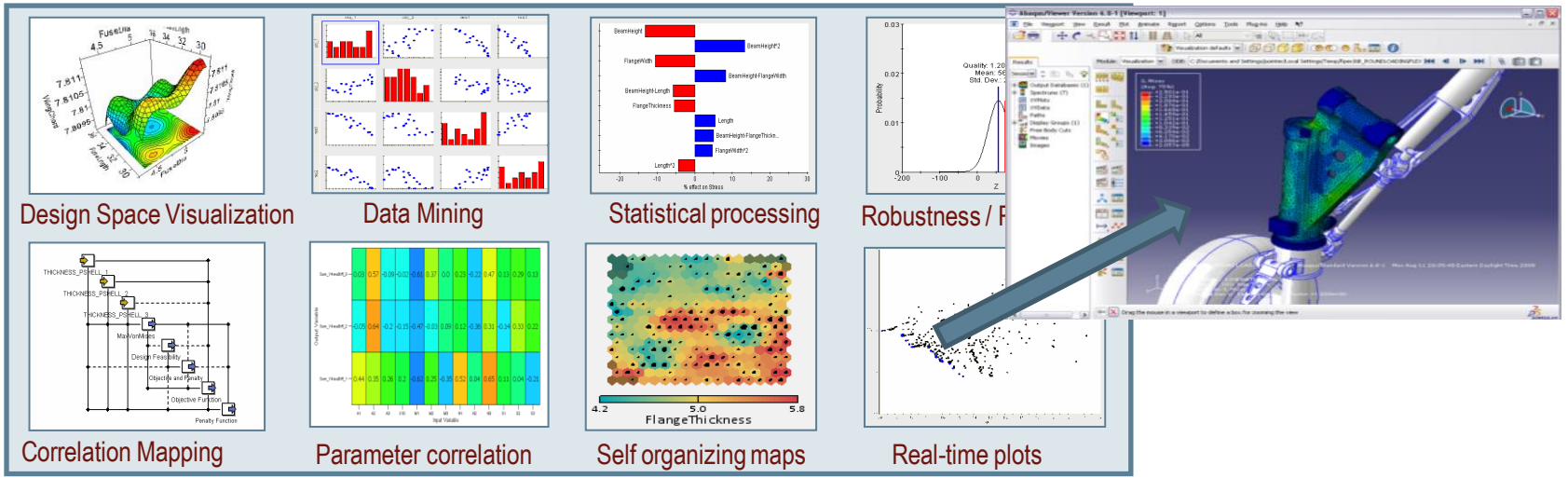
Processes in Isight, Components Example, Abaqus

- Automatic data exchange with Abaqus/CAE databases, (cae files)
- Automatic data exchange with Abaqus input files
- Configurable and extendible for exchange of data
  - Editable configuration file for exchanging data with Abaqus
    - Both on the input and output side of the CAE environment
- Abaqus solver execution user control:
  - “Wait for output file” support for use with stand alone machines and queuing systems
  - Included Grid handling, serial and parallel execution
- Automatic data exchange with Abaqus .odb and .dat files



Post- processes in Isight, Analysis of Alternative & Results

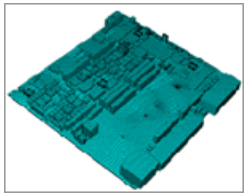
- Discover design possibilities and trade-offs throughout the design cycle
- Visualization of options enables innovation and customer collaboration
- Highly visual interfaces allow “surfing” the design space in “real time” for better decision support

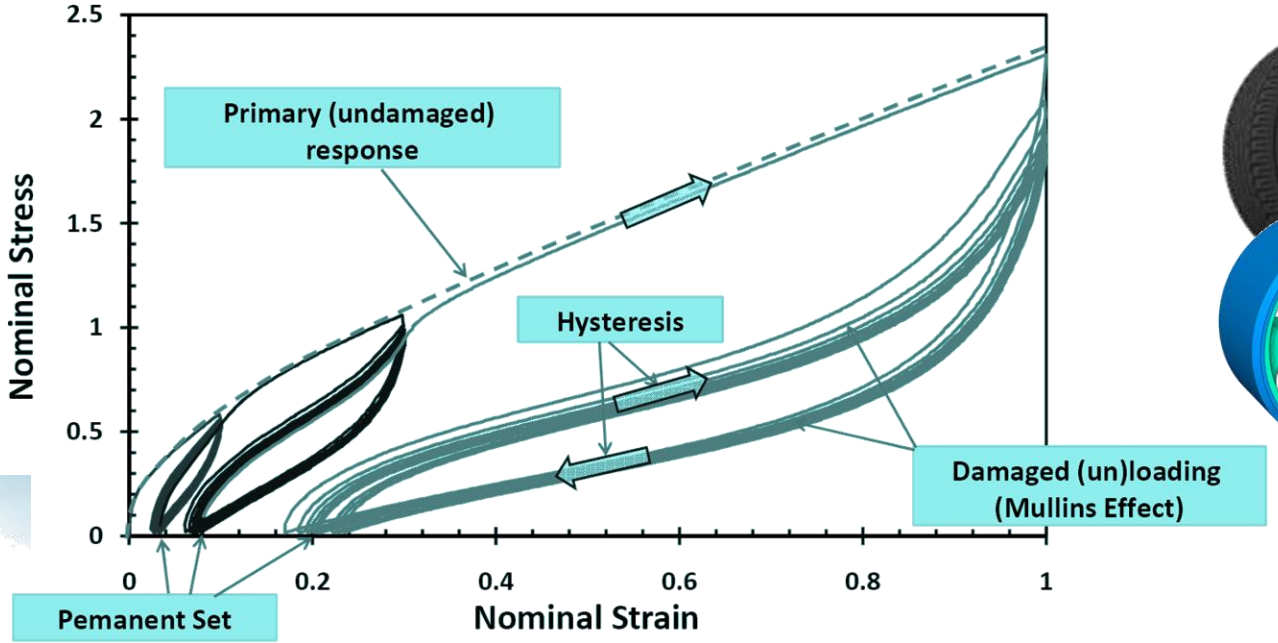


Isight used in abaqus material models

Transportation & Mobility | Life Sciences | Consumer Packaged Goods - Retail

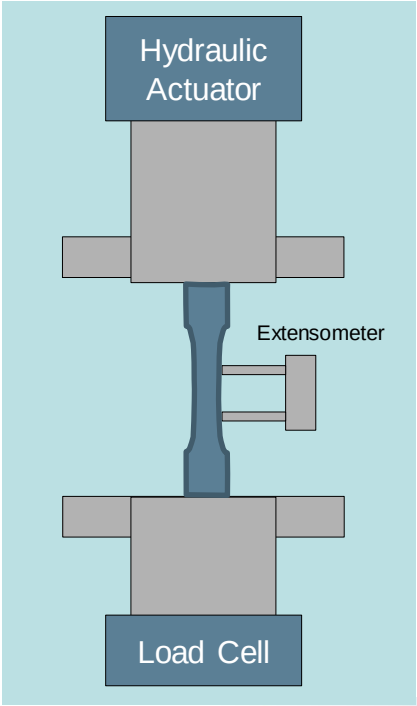
Parallel rheological framework for polymers in Abaqus





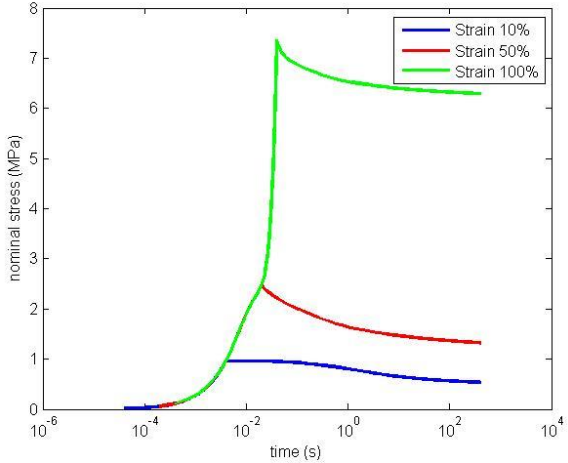
Manual operation on data or Process Automation in Isight

Experiments



Test data processing

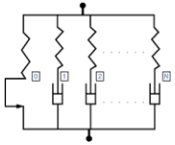
- Filter data
- Log data
- Etc.



Abaqus Material Model selection

viscoplastic

viscoelastic



$$\dot{\bar{\varepsilon}}^{cr} = \left(A\tilde{q}^n [(m+1)\bar{\varepsilon}^{cr}]^m \right)^{\frac{1}{m+1}},$$

$$\frac{d\bar{\varepsilon}^{cr}}{d\tau} = \frac{1}{a_T(\theta)} g^{cr}(\bar{\varepsilon}^{cr}, I_1^{cr}, \tilde{q}, \tau),$$

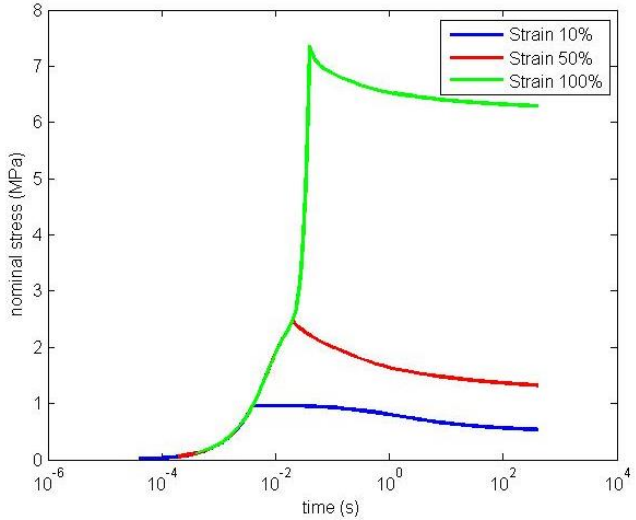
TRS effects

creep

(No) Option 1 : Manual parameter calibration

- Parallel Rheological Framework material model in Abaqus
- Hyper elastic data and 3 visco-elastic networks -> 15 more or less unknown parameters

Processed Test data



PRF material model in Abaqus

	c_{10}	C_{20}	c_{30}
	?	?	?
S1	A1	n1	m1
?	?	?	?
S2	A2	n2	m2
?	?	?	?
S3	A3	n3	m3
?	?	?	?

Option 2 : Use Isight to calibrate the PRF Model

- One element Abaqus model
- Very simple workflow with Pointer 2 Algorithm as driver

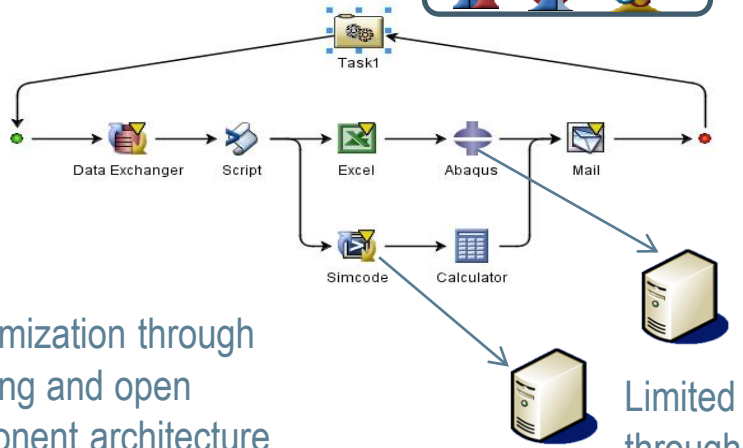
	C_{10}	C_{20}	C_{30}
	1.860	- 0.911	0.574
S1	A1	n1	m1
0.184	6.612	2.622	- 0.093
S2	A2	n2	m2
0.225	26.493	3.646	- 0.147
S3	A3	n3	m3
0.189	3.993	4.666	- 0.516

Execution options :
Isight as Desktop application

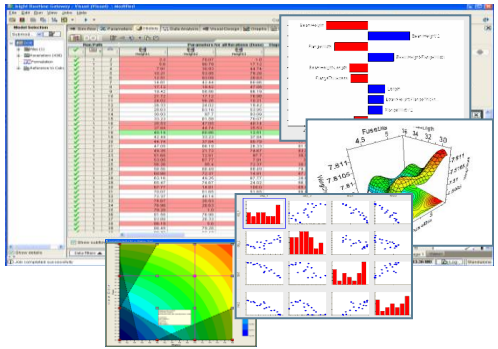
Single Desktop User

Simulation process flow modeling

Design Exploration



Interactive Data Analysis

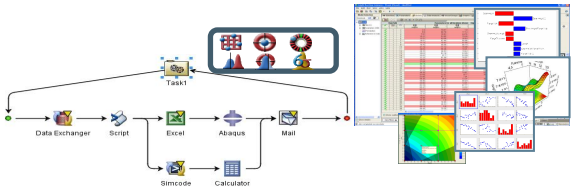


Customization through scripting and open component architecture

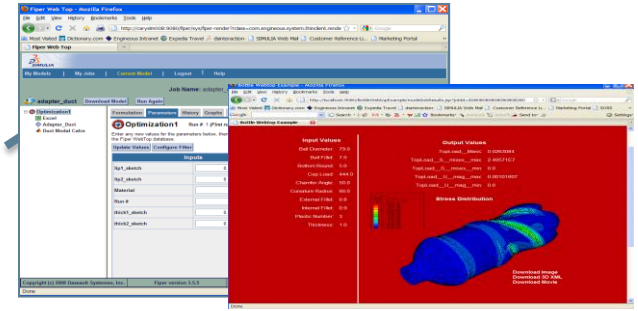
Limited distributed computing through LSF, SSH, PBS/Torque (specific components only)

Execution options :
Beyond the Desktop, SIMULIA Execution Engine

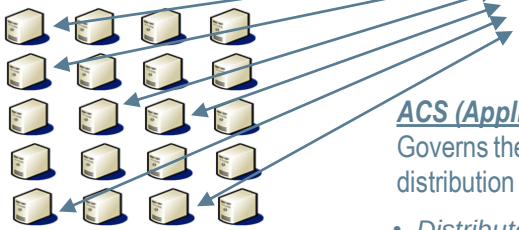
Single Desktop User



Webtop/ Custom Web Interfaces



Distributed Resource Management



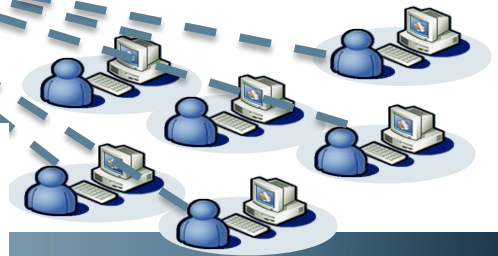
SIMULIA Execution Engine ACS

Stations
(clients communicating with ACS)

ACS (Application Control Server):
Governs the execution of the workflow and the distribution of work to Stations

- *Distributed heterogeneous execution*
- *Parallel simflow execution*
- *Work item load balancing (true load balancing through use of LSF)*

Collaboration



Summary

Isight Delivers Significant, Measurable Benefits

- Reduce Engineering Cycle Times
- Improve product performance and quality
- Reduce product, and/or manufacturing costs
- Improve product reliability
- Other benefits; risk-reduction, reduced testing, etc…

Suitable Isight implementations

- Frequently used coupled software applications
- Automation of well defined processes
- Design Exploration and Optimization
- Multi-Software processes including conditional workflows