

Lecture 2

Introduction to ANSYS Workbench

14.0 Release

The banner features four distinct 3D visualizations: a blue fluid flow field on the left, a purple gear with a glowing center, a green concentric circle pattern, and a stack of teal cubes on the right.

Fluid Dynamics

Structural Mechanics

Electromagnetics

Systems and Multiphysics

Introduction to ANSYS DesignModeler

ANSYS Workbench 14

What will you learn from this presentation

- **Overview of ANSYS Workbench**
- **How to launch Workbench?**
- **Workbench interface details**
- **Workbench file structure**

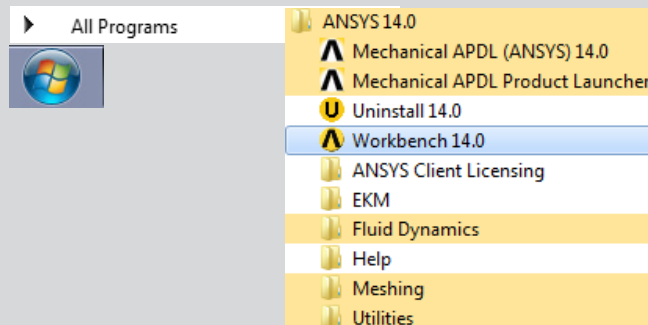
What is Workbench

***Next Generation* engineering simulation environment from ANSYS**

- A platform that combines the strength of core solvers with product management tools for better project and data management
 - *Integration framework*
 - Integrates existing ANSYS technologies/applications
 - Allows for rapid integration of 3rd party applications
 - *Application framework*
 - Develop new, state of the art user interface, applications, UI tool kits
 - *Common tools and services*
 - Native data management
 - Parameter management and design points, units, expressions and journaling, scripting and batch execution

Launching Workbench

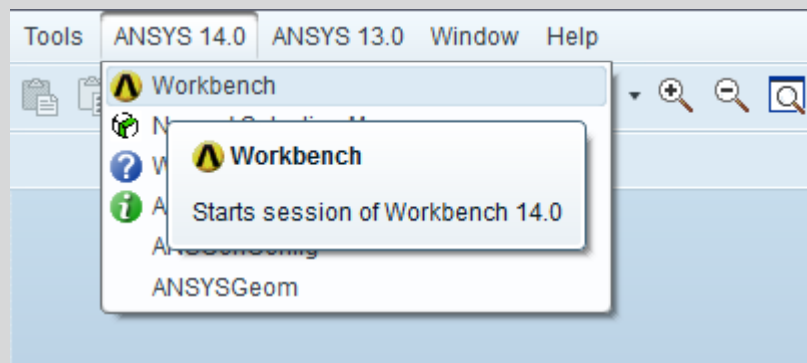
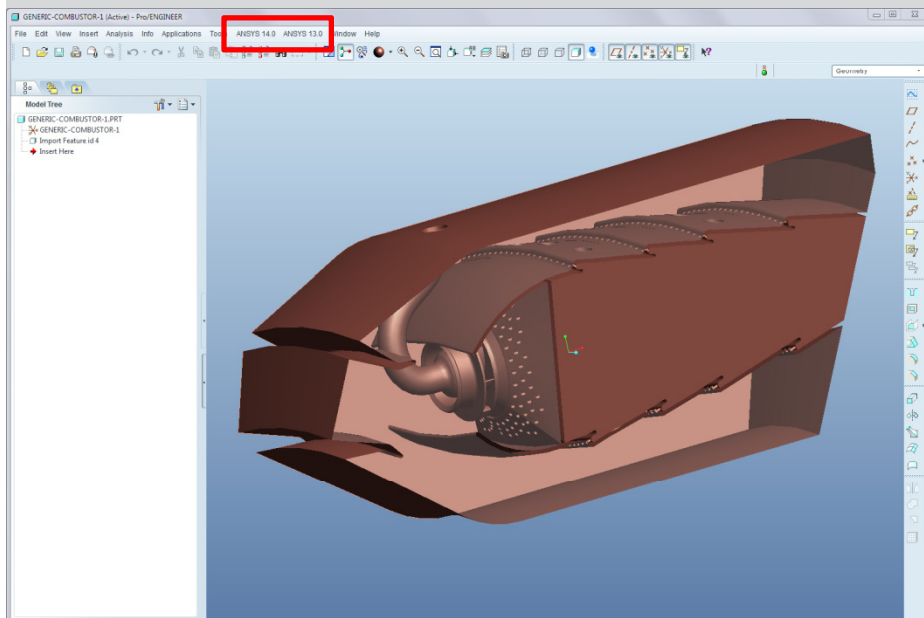
From Windows OS :



From UNIX/Linux OS :

`~/ansys_inc/v140/Framework/bin/Linux64/runwb2 &`

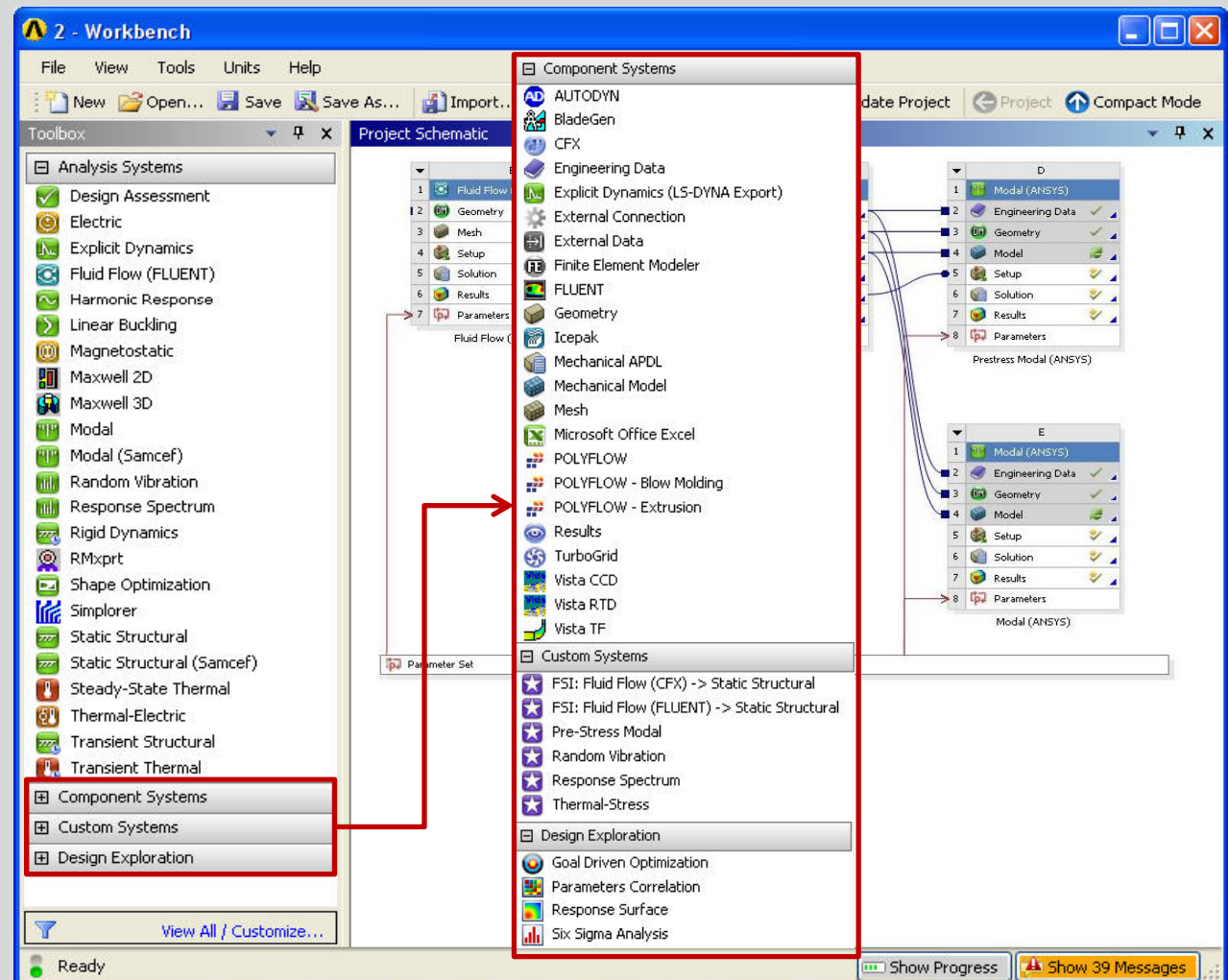
From CAD system :



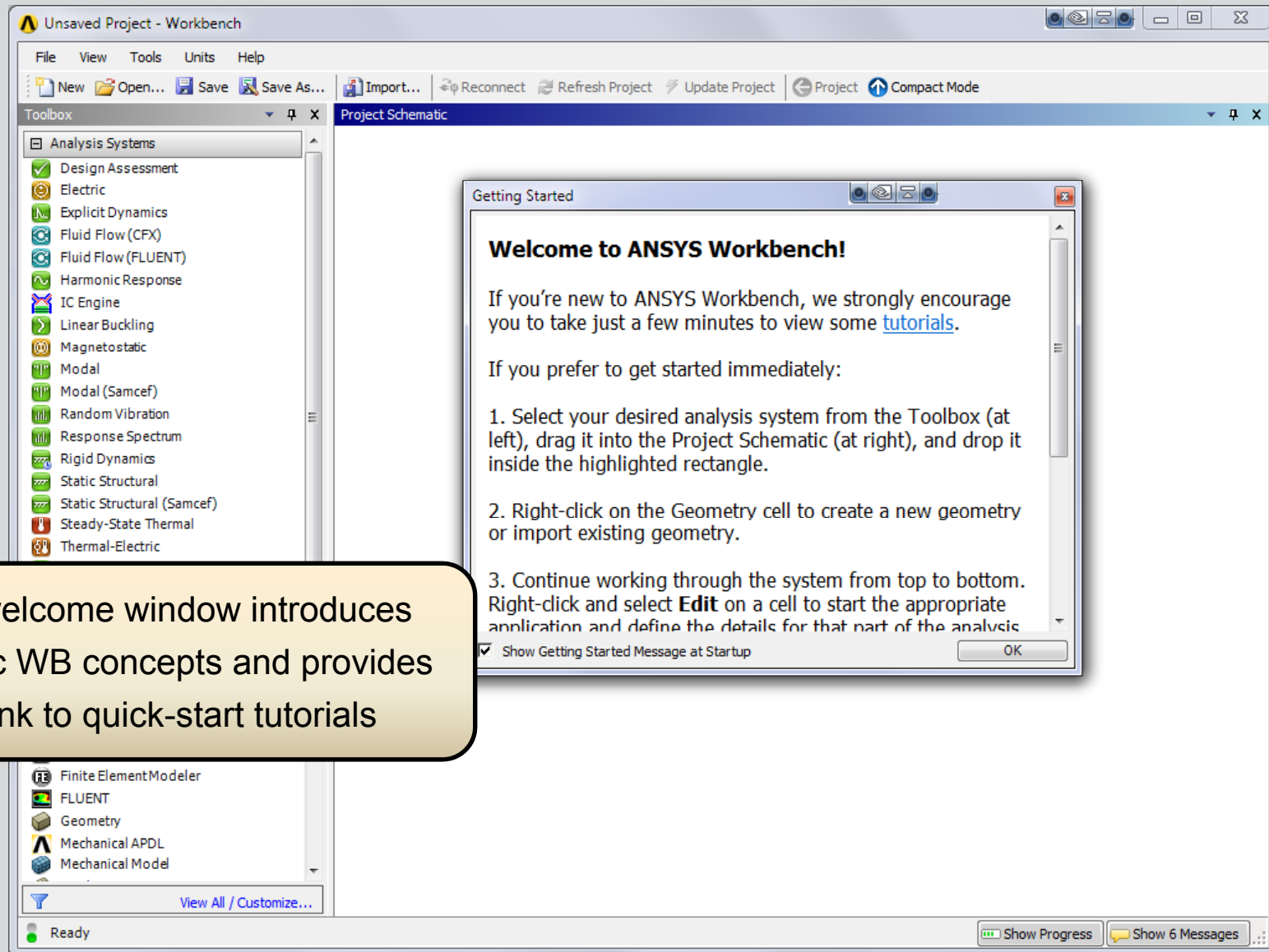
- Workbench supports various CAD packages
- Details are covered in CAD Connectivity presentation

Which Tools are Hosted on Workbench

- Not just limited to geometry or meshing
- Not just limited to CFD / CSM
- Not just limited to single physics, includes Multi-physics too
- Electromagnetic tools
- Design Exploration and Parameterization



Project Management System



A welcome window introduces basic WB concepts and provides link to quick-start tutorials

Complete Analysis Systems

The screenshot shows the ANSYS Workbench interface. On the left, the 'Toolbox' contains a list of 'Analysis Systems'. The 'Fluid Flow (CFX)' system is highlighted. On the right, the 'Project Schematic' shows a sequence of steps: 1. Fluid Flow (CFX), 2. Geometry, 3. Mesh, 4. Setup, 5. Solution, and 6. Results. A callout box points to the 'Fluid Flow (CFX)' system in the toolbox, and another callout box points to the 'Fluid Flow (CFX)' step in the schematic.

The Analysis Systems group contains a set of pre-defined systems listed by analysis type (and solver)

The Toolbox contains Systems which are the building blocks of the Project

Drag the desired analysis type onto the Project Schematic

Guided Workflow

The screenshot shows the ANSYS Workbench interface. On the left is the 'Analysis Systems' tree, listing various analysis types such as Design Assessment, Electric, Explicit Dynamics, Fluid Flow (Blow Molding (POLYFLOW)), Fluid Flow (Extrusion (POLYFLOW)), Fluid Flow (CFX), Fluid Flow (FLUENT), Fluid Flow (POLYFLOW), Harmonic Response, Linear Buckling, Magnetostatic, Maxwell 2D, Maxwell 3D, Modal, Modal (Samcef), Random Vibration, Response Spectrum, Rigid Dynamics, RMXprt, Shape Optimization, Simplorer, Static Structural, Static Structural (Samcef), Steady-State Thermal, Thermal-Electric, Transient Structural, and Transient Thermal. Below this are 'Component Systems', 'Custom Systems', and 'Design Exploration'. A large yellow arrow points from the 'Analysis Systems' tree to the 'Fluid Flow (CFX)' workflow steps.

The 'Fluid Flow (CFX)' workflow steps are listed in a table:

1	Fluid Flow (CFX)		
2	Geometry	✓	
3	Mesh	↻	
4	Setup	?	
5	Solution	?	
6	Results	?	

Below the table is the text 'Fluid Flow (CFX)'. A blue dotted arrow points from the 'Setup' step to the 'State icons' callout box.

System components guide the user through the analysis process

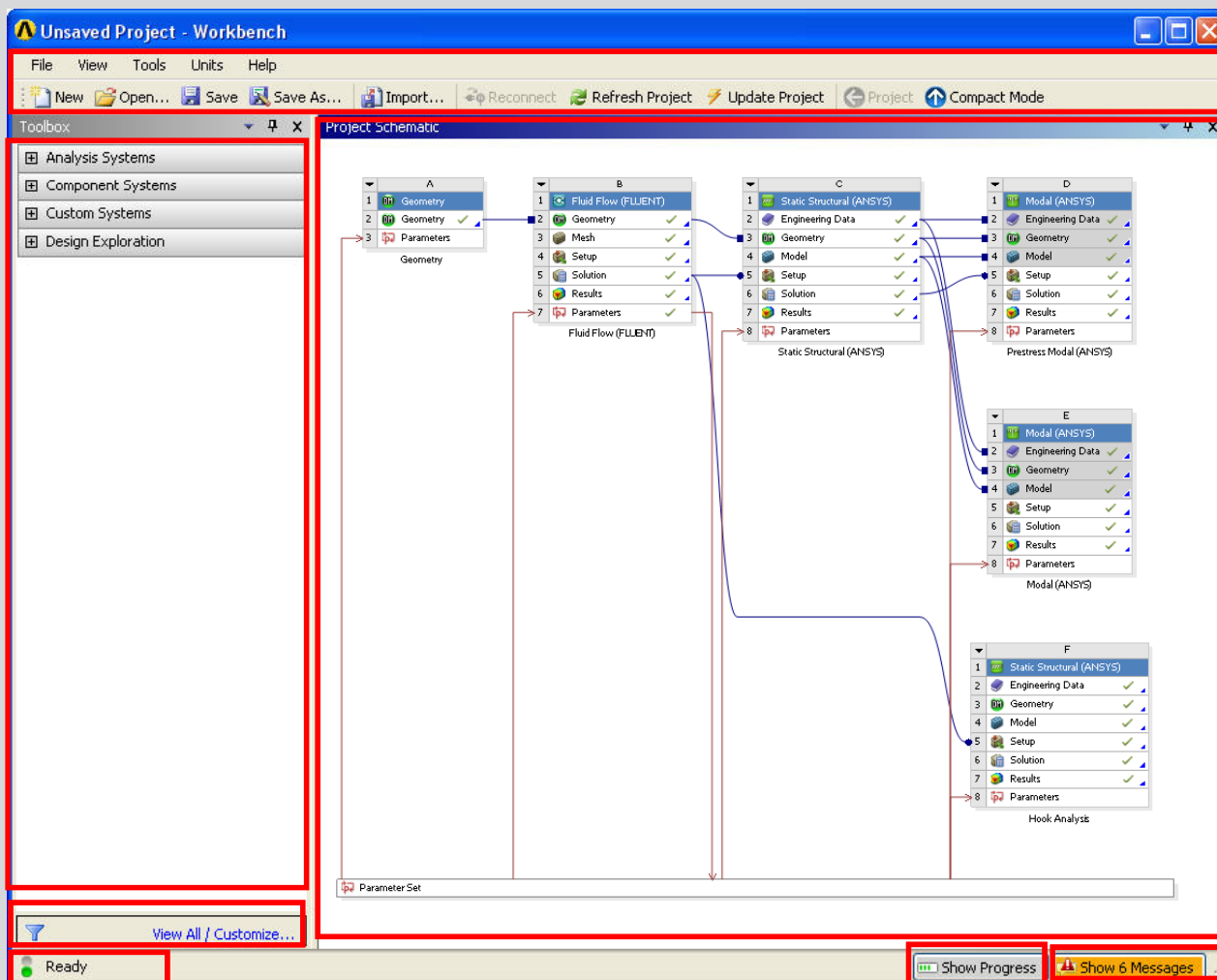
State icons inform the user of progress and suggest where action needs to be taken

Workbench Environment

Main Menu
Bar

Toolbox

Customize
Toolbox



Project
Schematic

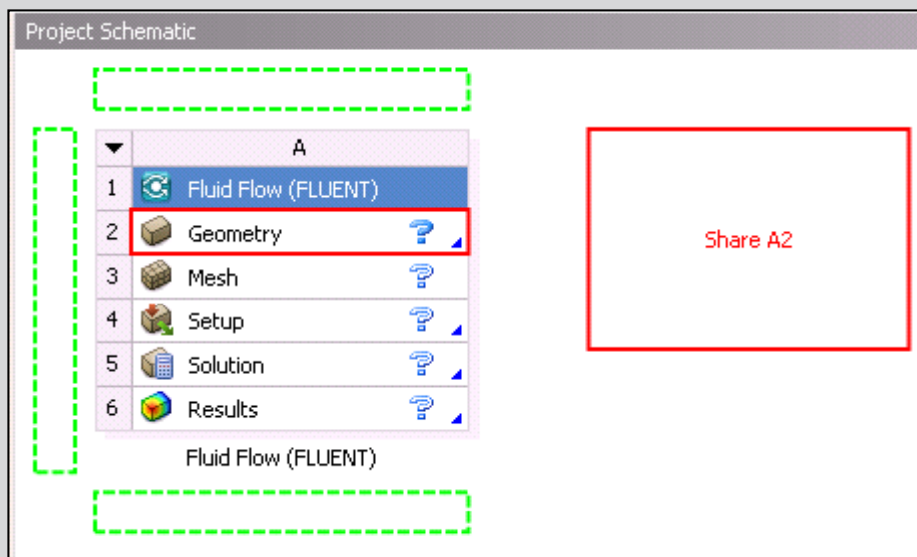
Message
Window

Project Status

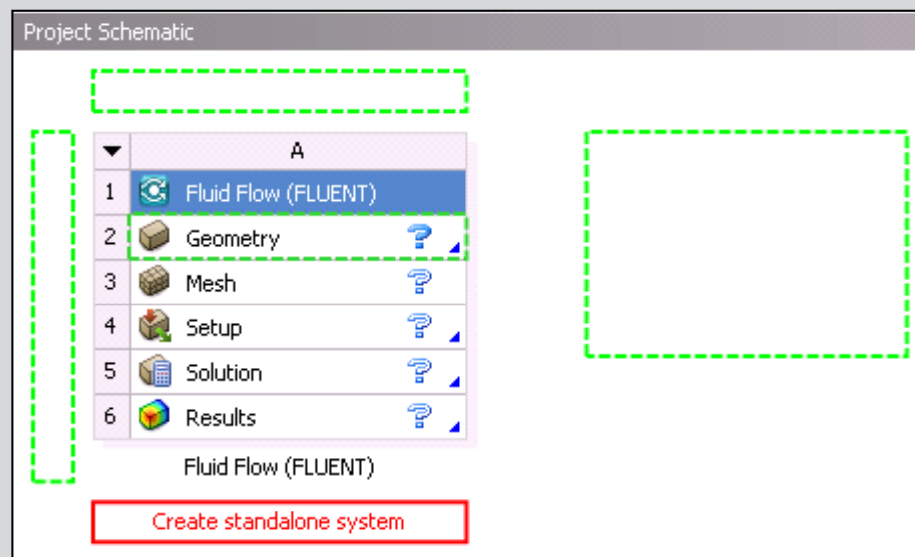
Progress Window

Project Schematic

- Just 'drag and drop' Analysis or Component or Custom Systems into the schematic to create the Project layout
- The location of drop, dictates the *"type of linkage"* between systems
- The *"type of linkage"* is indicated by the *"type of connector"* between the systems

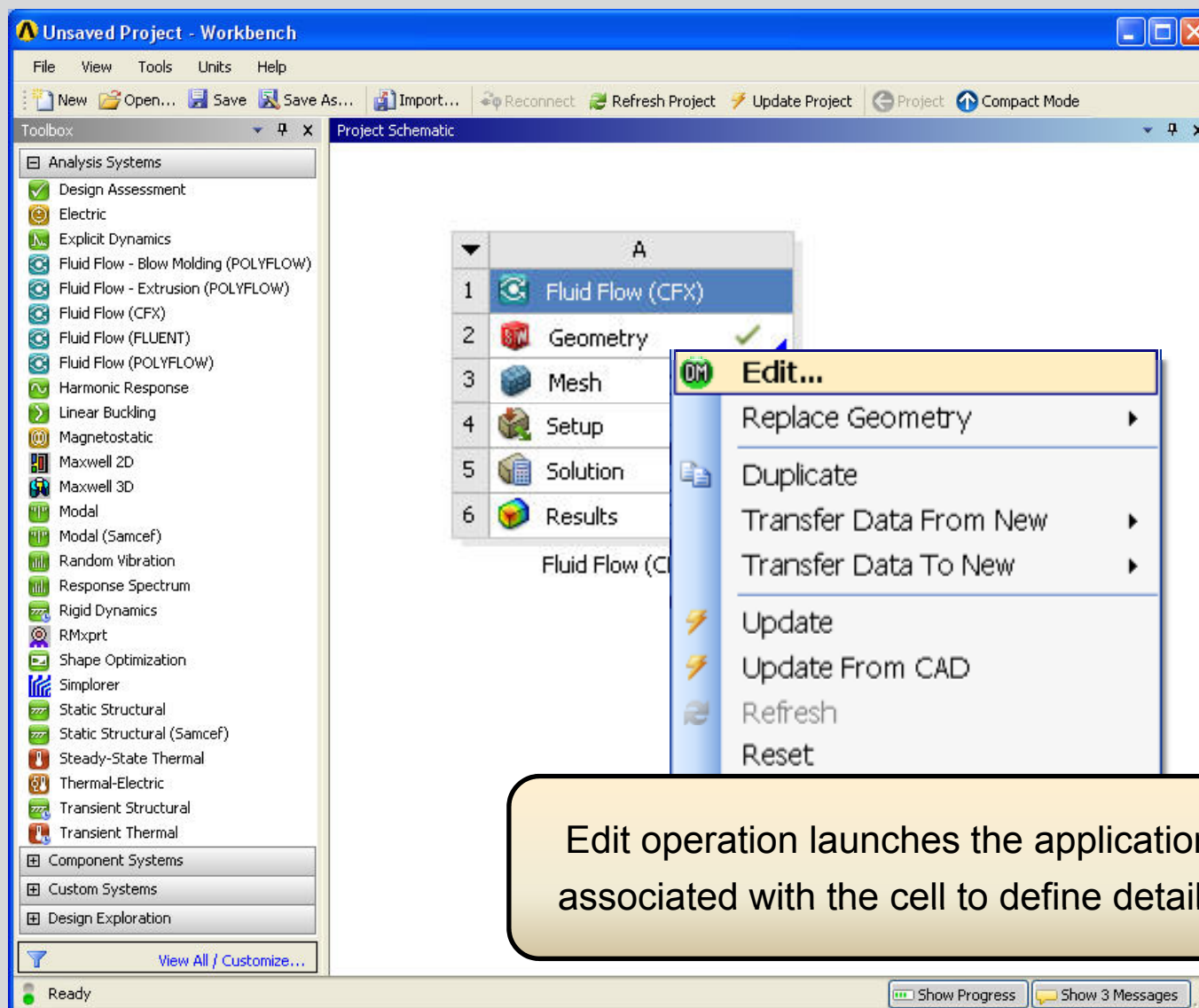


Share Component

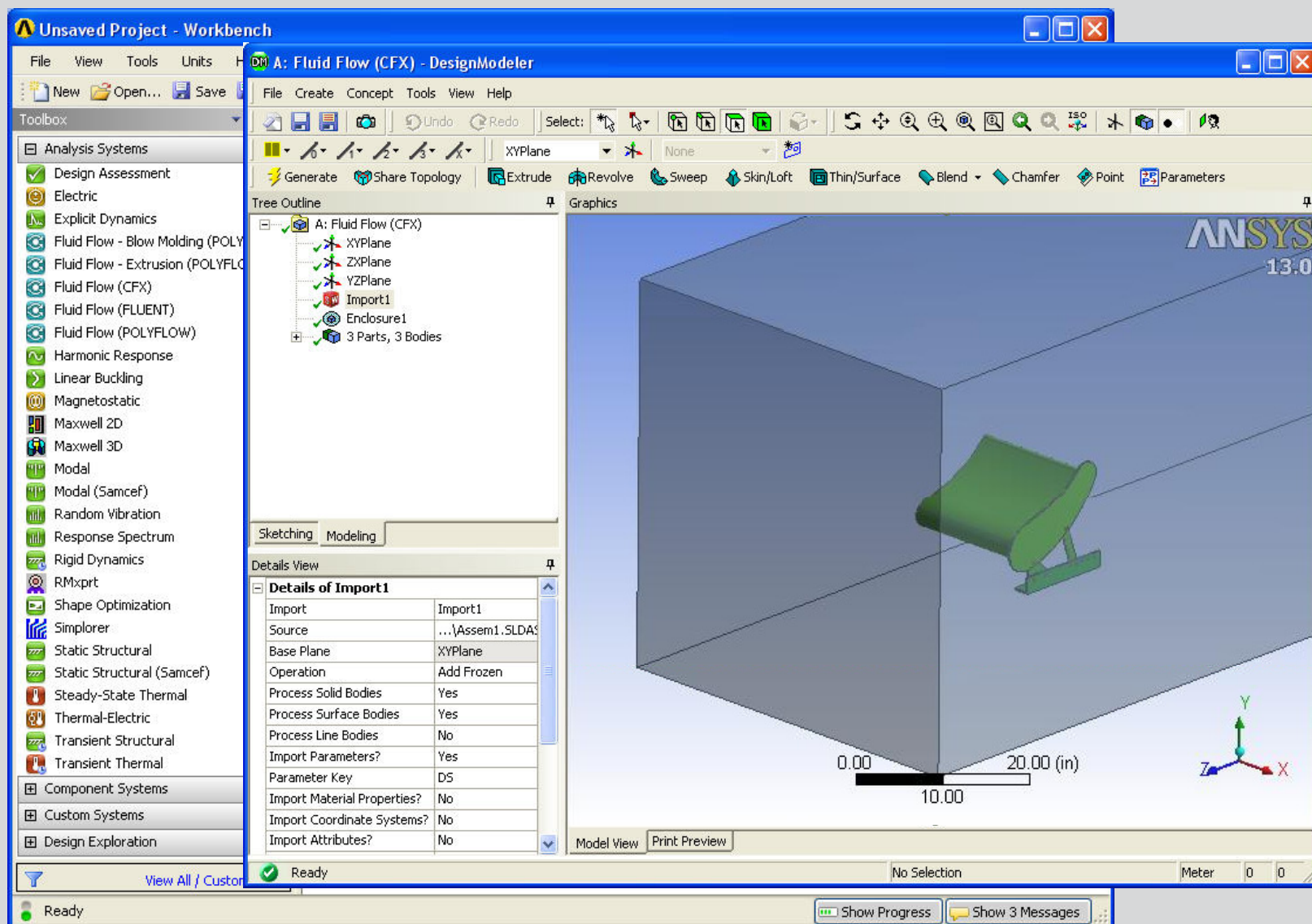


Create Standalone System

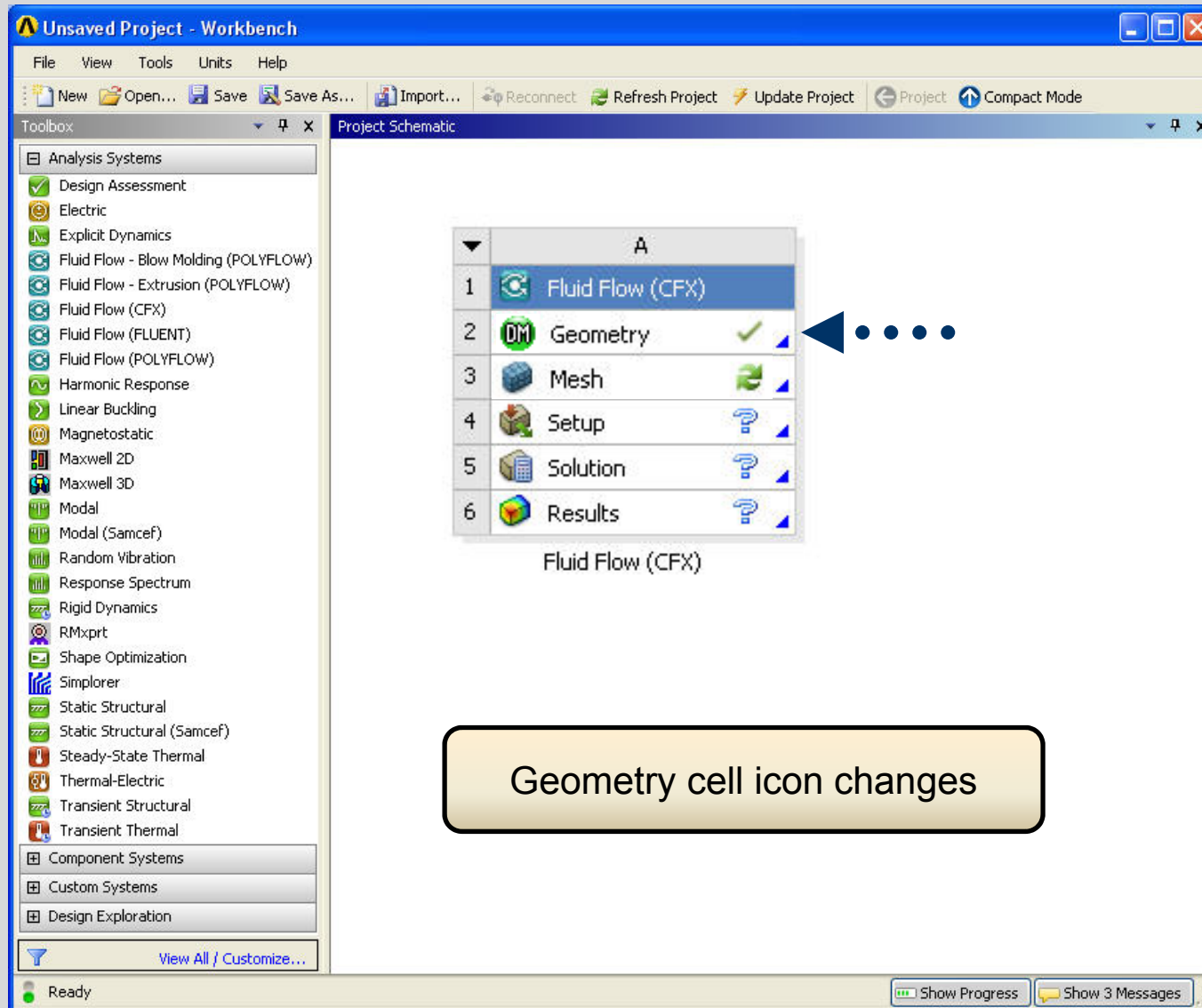
Using ANSYS Workbench “Editors” (1)



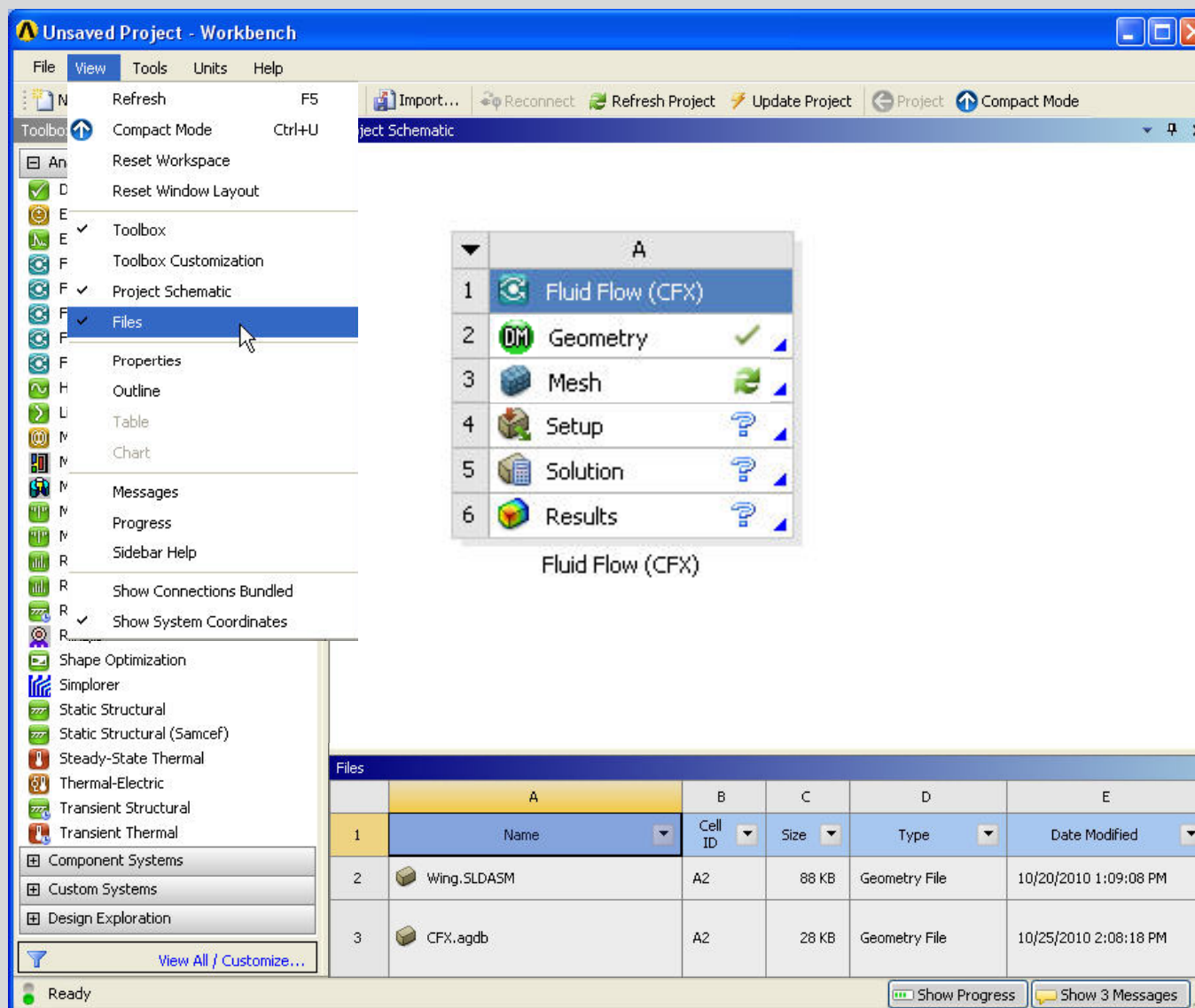
Using ANSYS Workbench “Editors” (2)



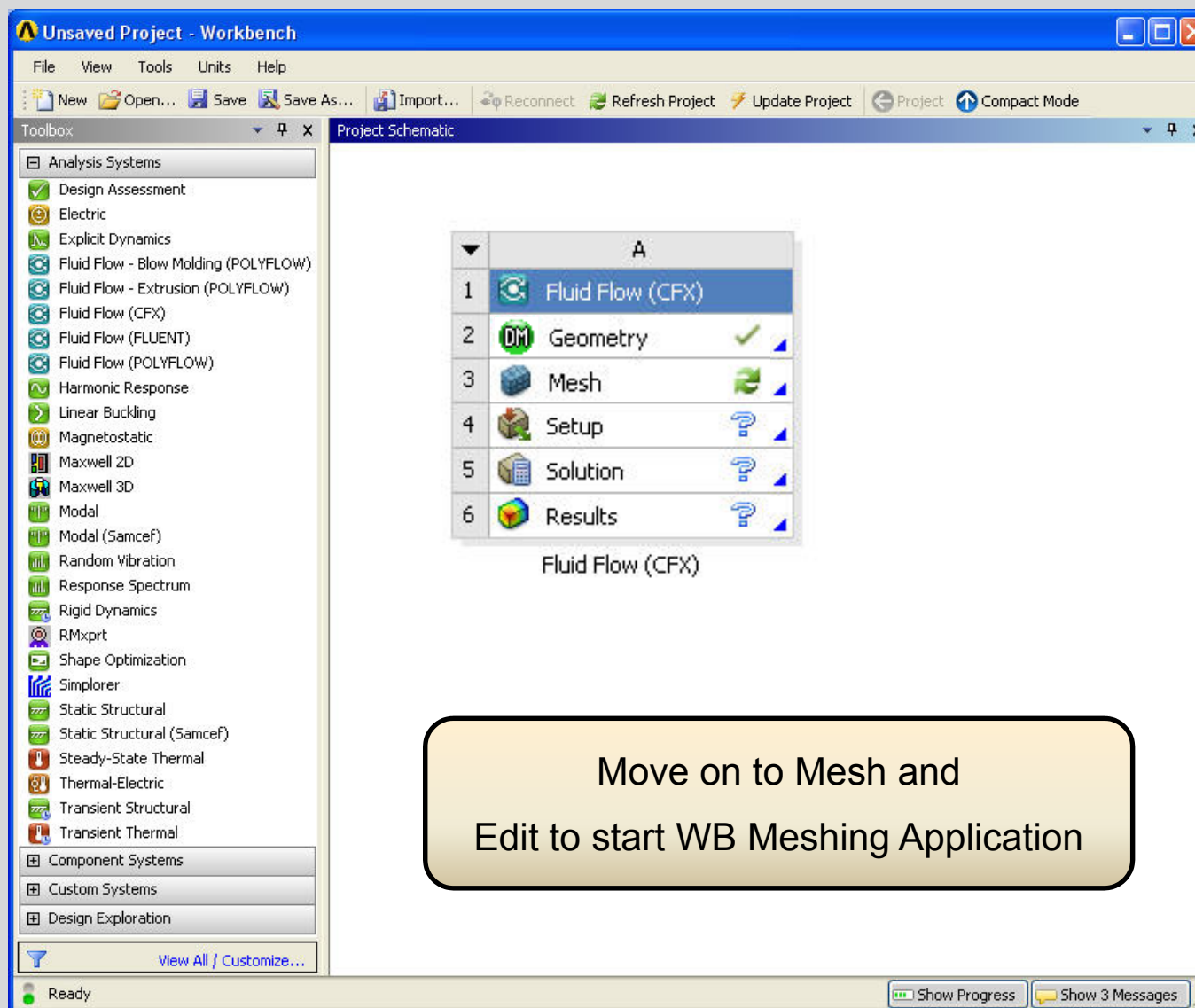
Using ANSYS Workbench “Editors” (3)



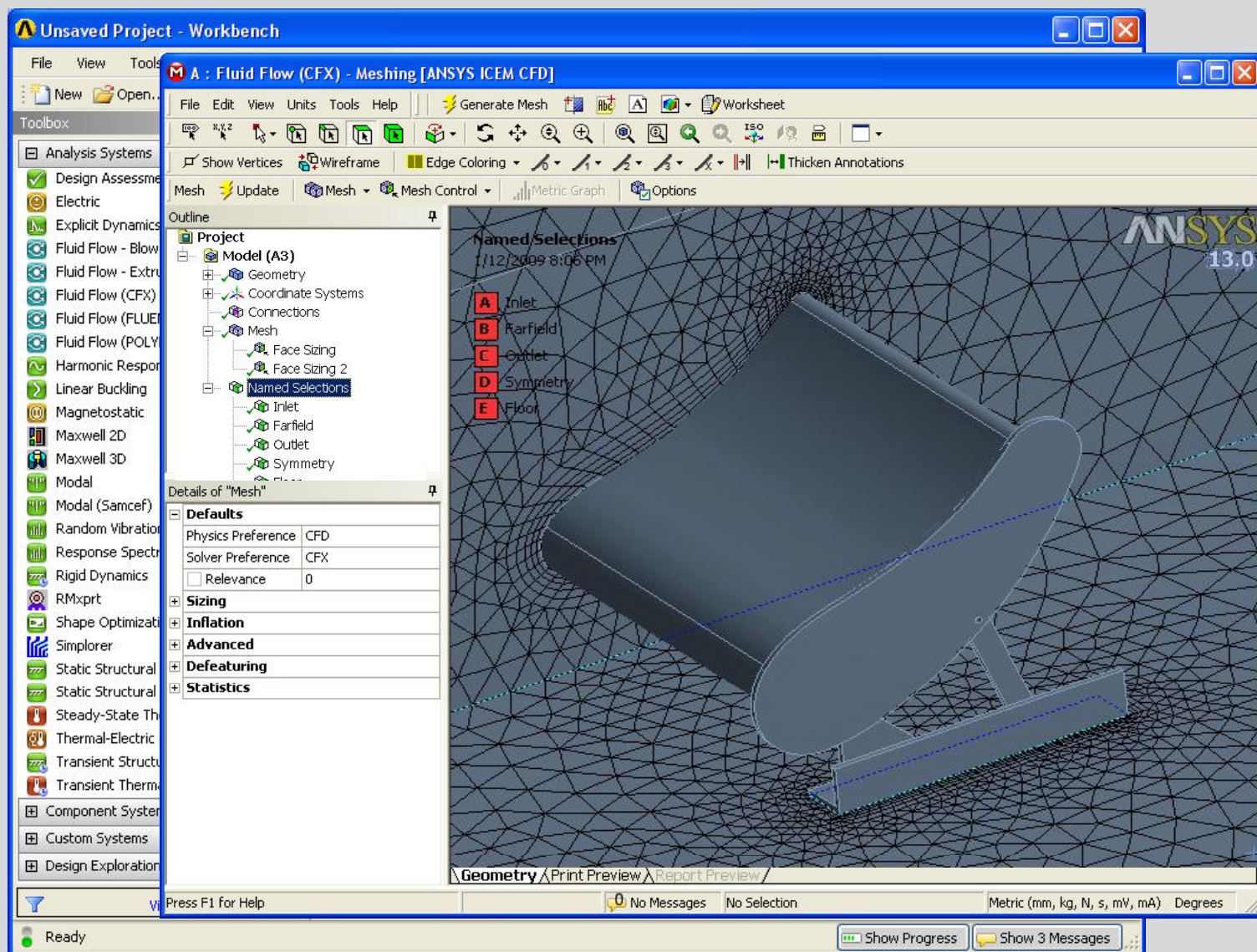
Automated File and Data Management



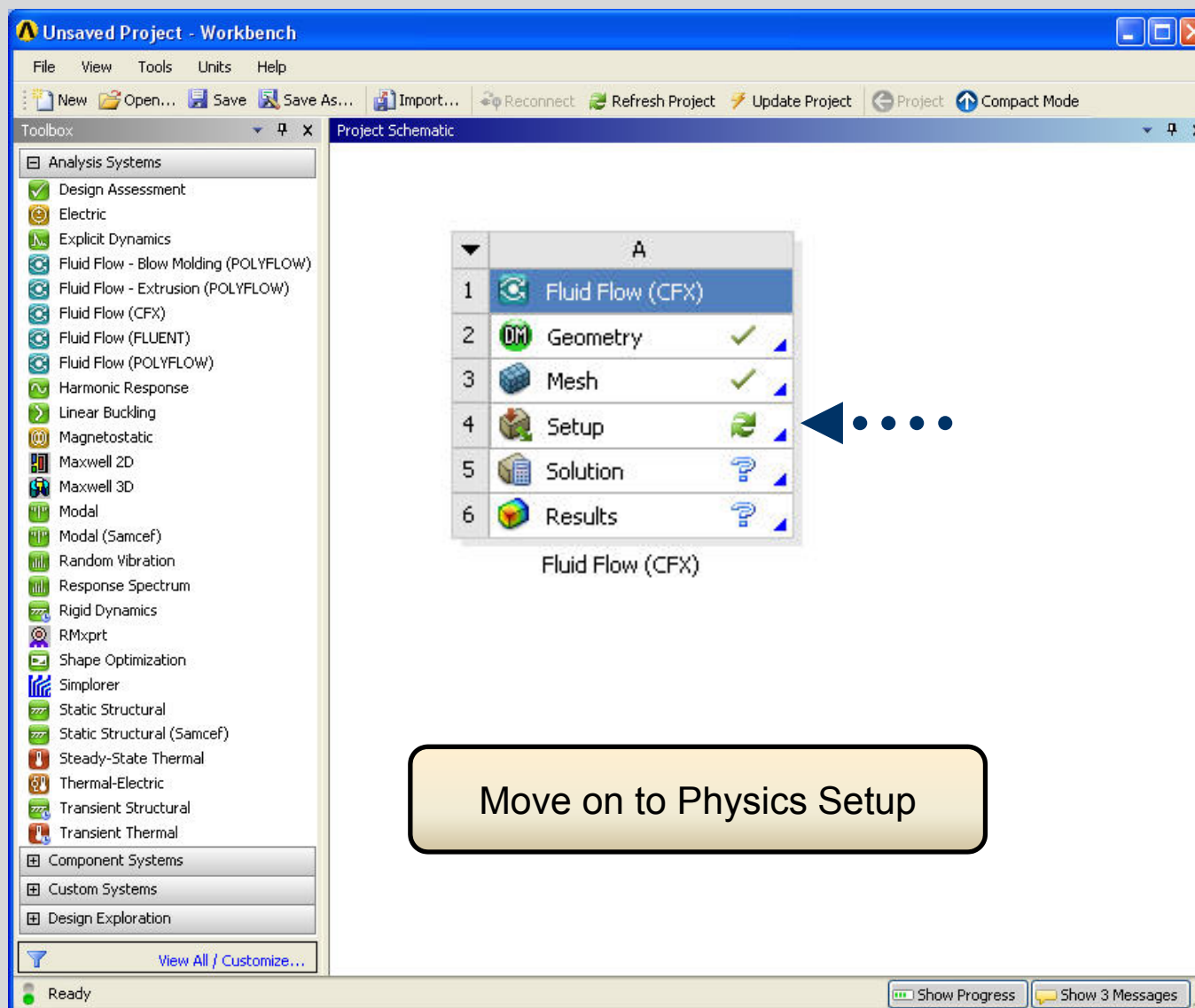
Meshing at ANSYS Workbench (1)



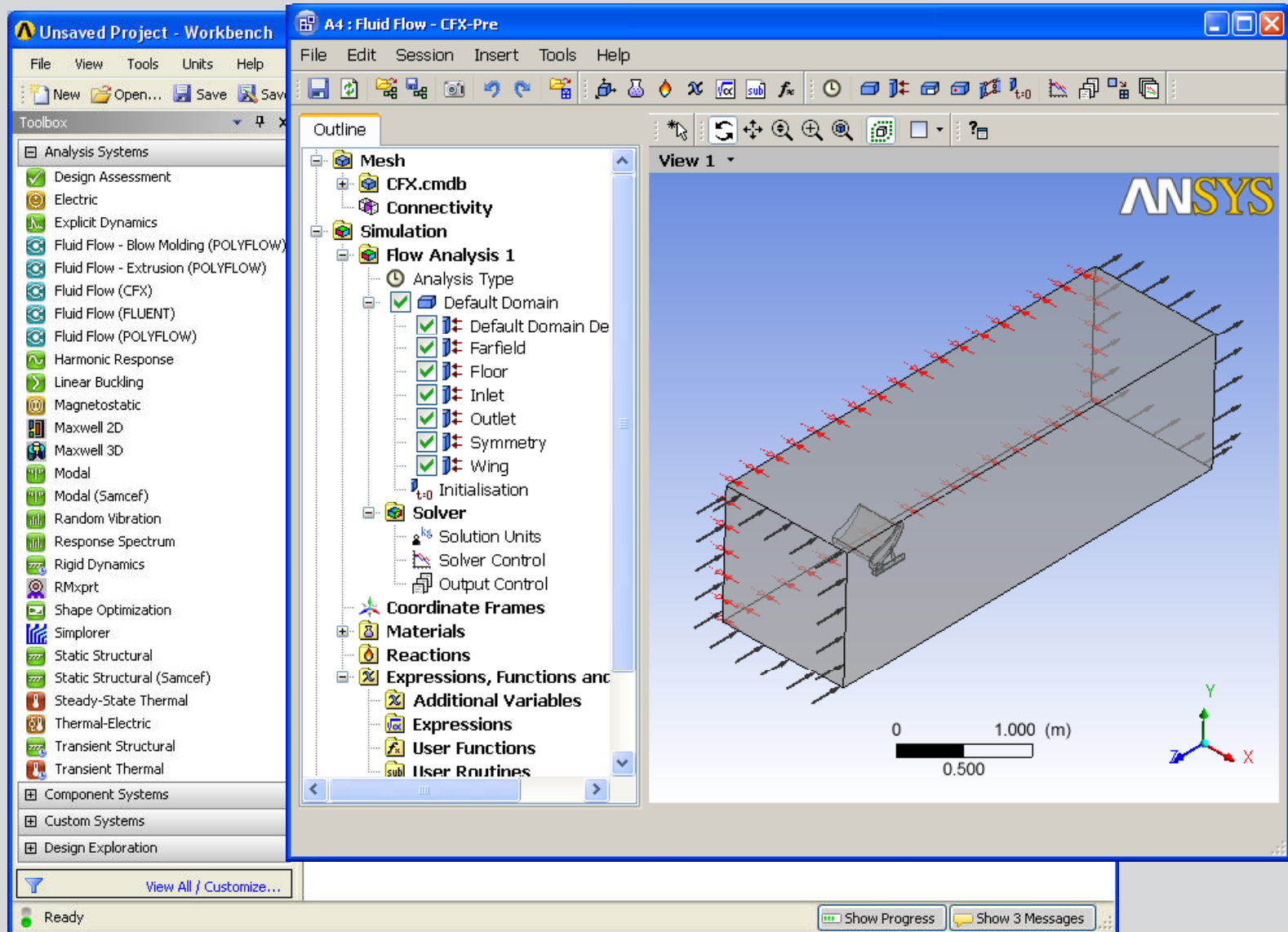
Meshing at ANSYS Workbench (2)



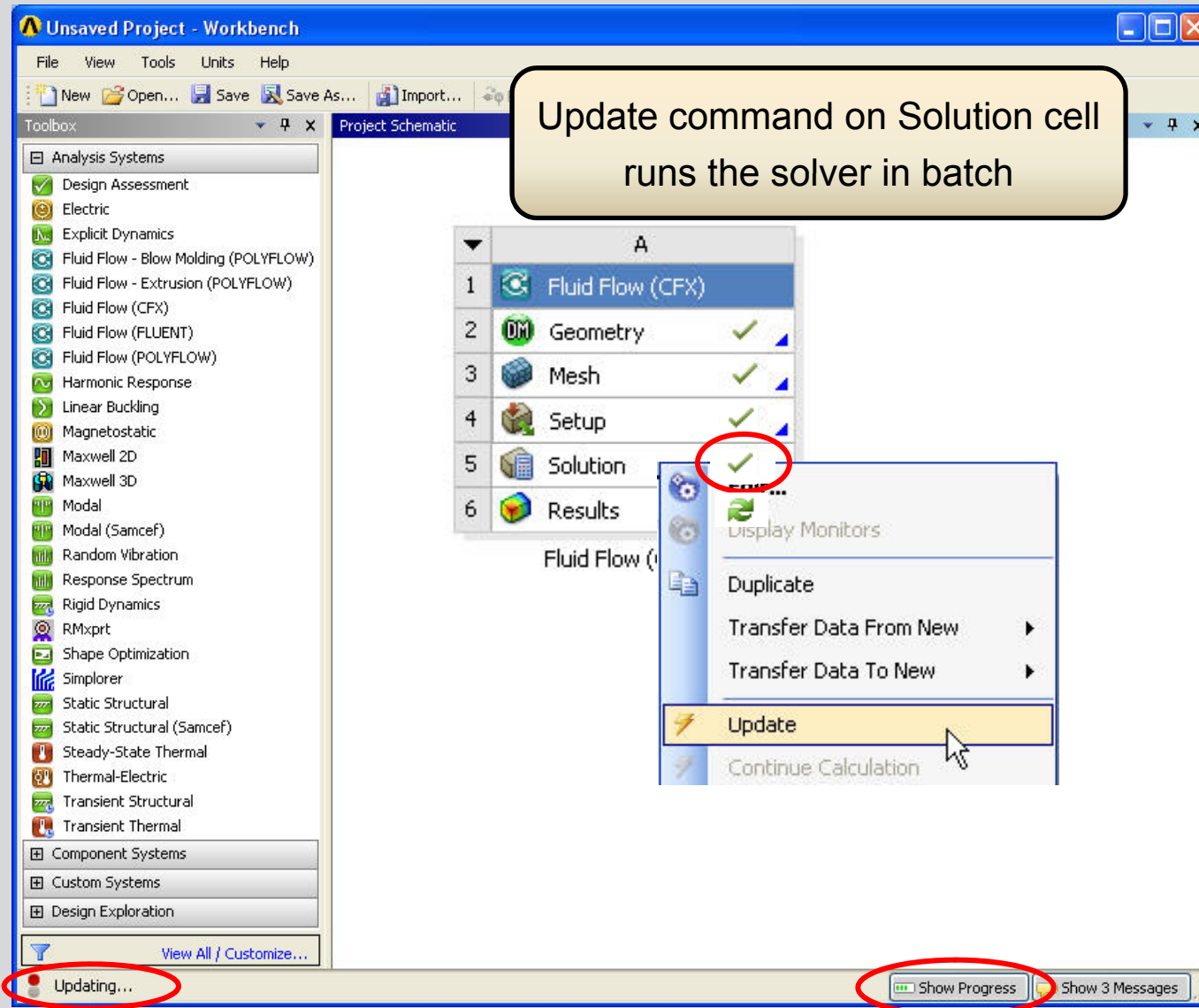
Working Through the System (1)



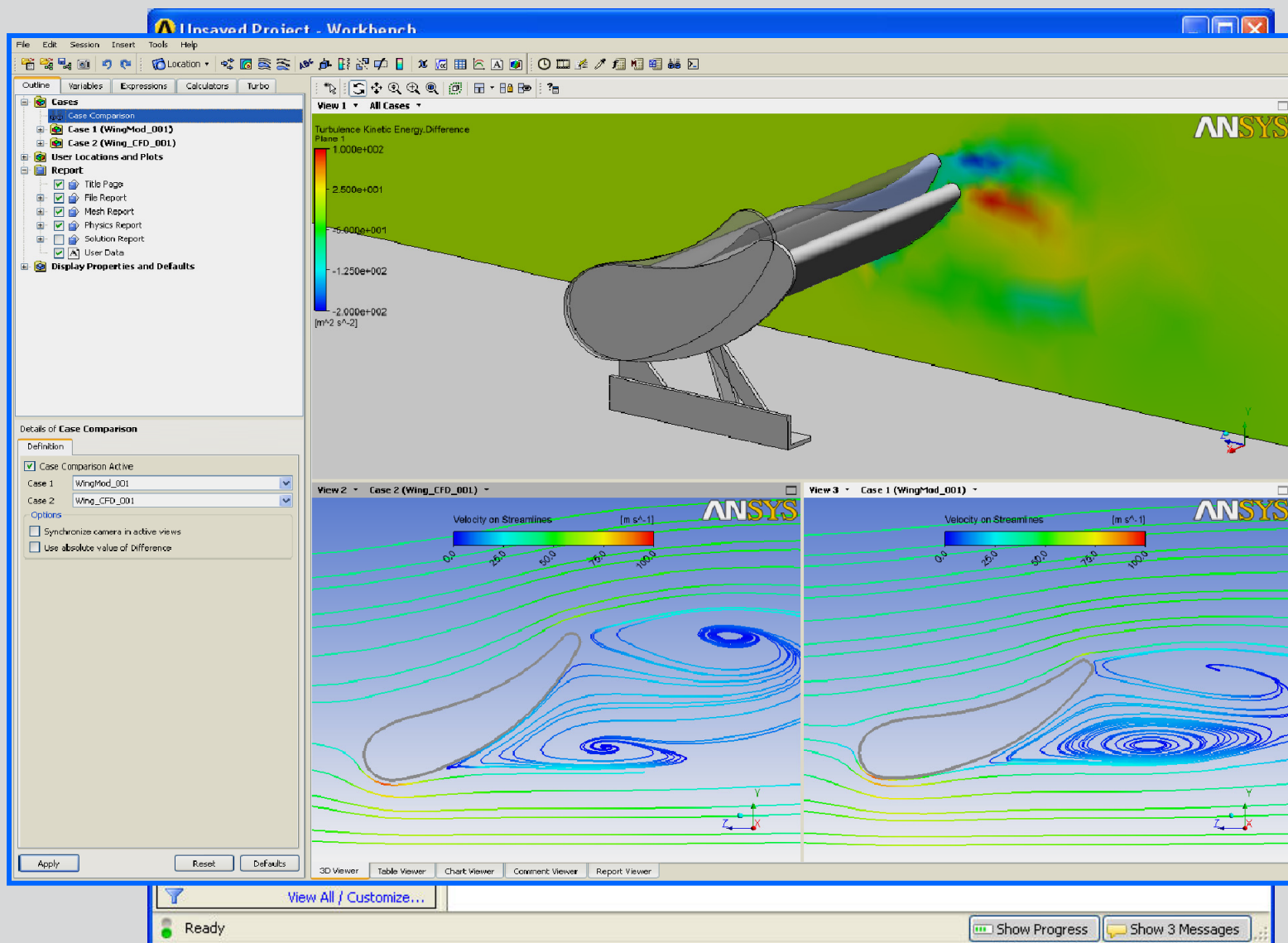
Working Through the System (2)



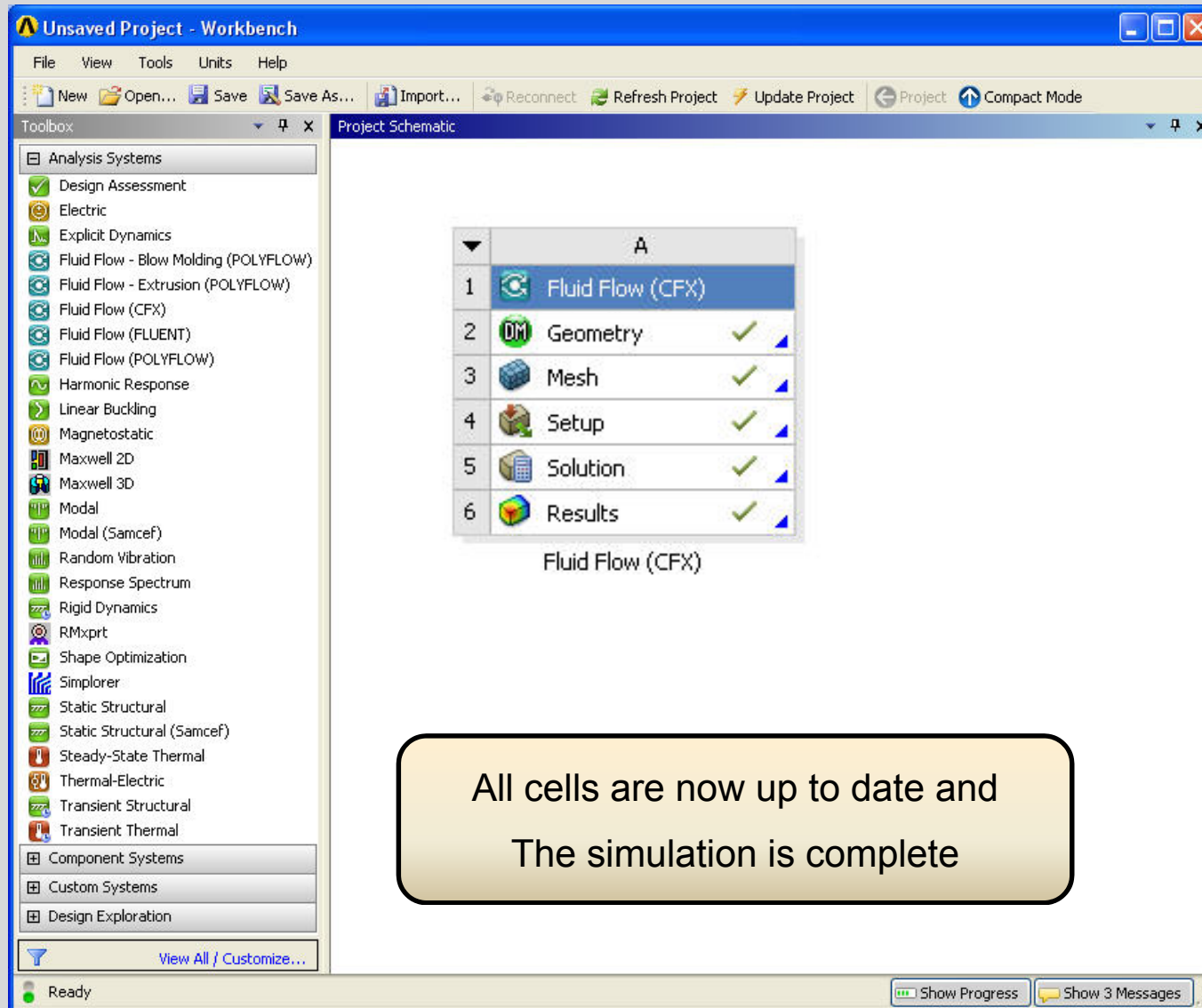
Solving in Batch Mode from Project Using Update



Post-Processing the Results (1)



Post-Processing the Results (2)



Icons Show the State of Project Data

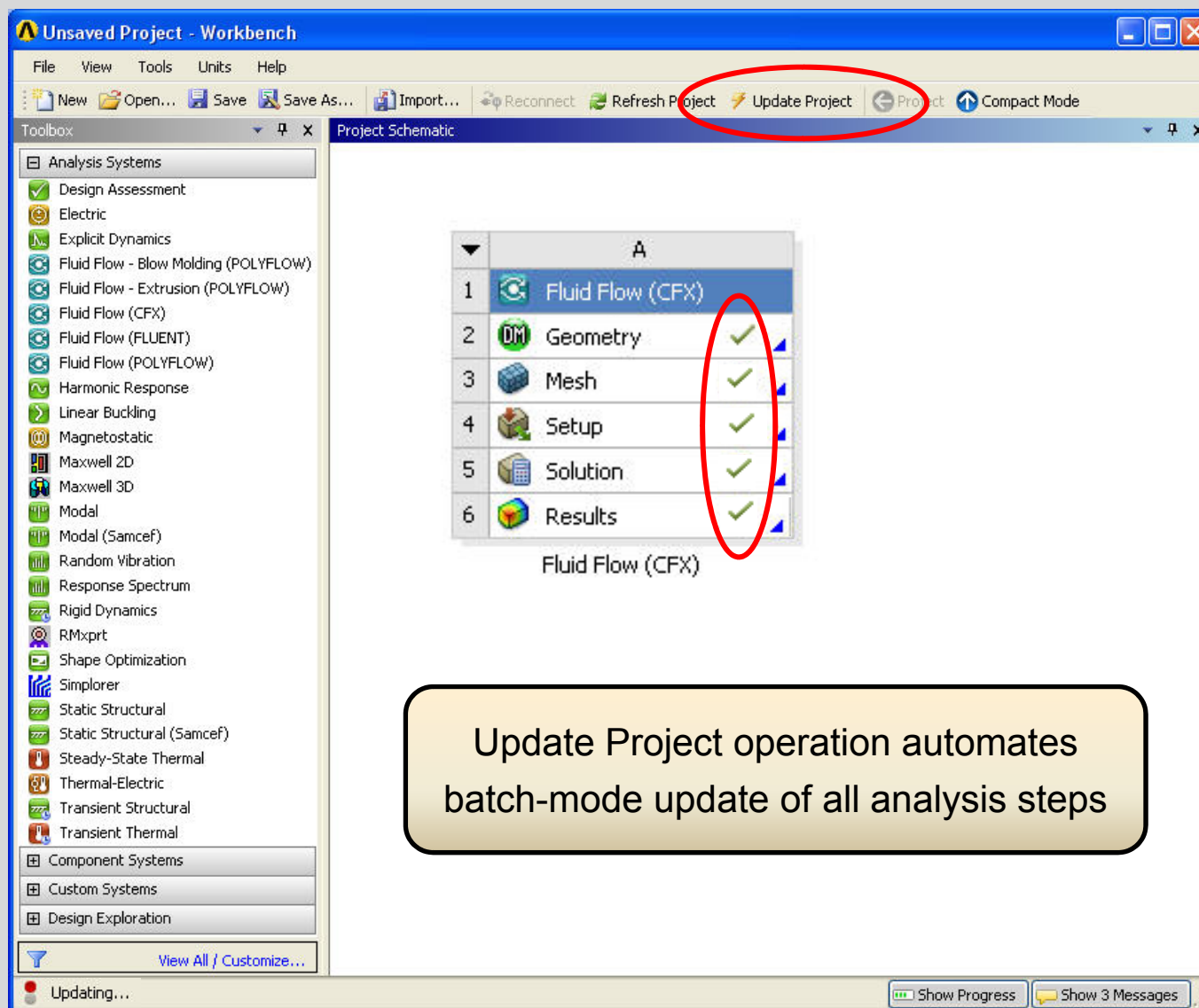
What happens if we make a change to the Geometry?

State icons clearly indicate upstream changes have been made

The screenshot shows the ANSYS Workbench interface. On the left is the 'Toolbox' containing various analysis systems. In the center is the project hierarchy for 'A', showing a sequence of steps: Fluid Flow (CFX), Geometry, Mesh, Setup, Solution, and Results. Each step has a state icon to its right. The 'Geometry' step (step 2) has a green checkmark icon, indicating it is the current step and has been updated. The 'Mesh' step (step 3) has a green circular arrow icon, indicating it is out of date and needs to be regenerated. The 'Setup' (step 4), 'Solution' (step 5), and 'Results' (step 6) steps all have green checkmark icons, indicating they are up to date. The 'Fluid Flow (CFX)' step (step 1) has a blue circular arrow icon, indicating it is out of date and needs to be regenerated. The status bar at the bottom shows 'Ready' and 'Show 3 Messages'.

Step	Icon	State
1	Blue circular arrow	Out of date
2	Green checkmark	Current / Up to date
3	Green circular arrow	Out of date
4	Green checkmark	Up to date
5	Green checkmark	Up to date
6	Green checkmark	Up to date

Update Project

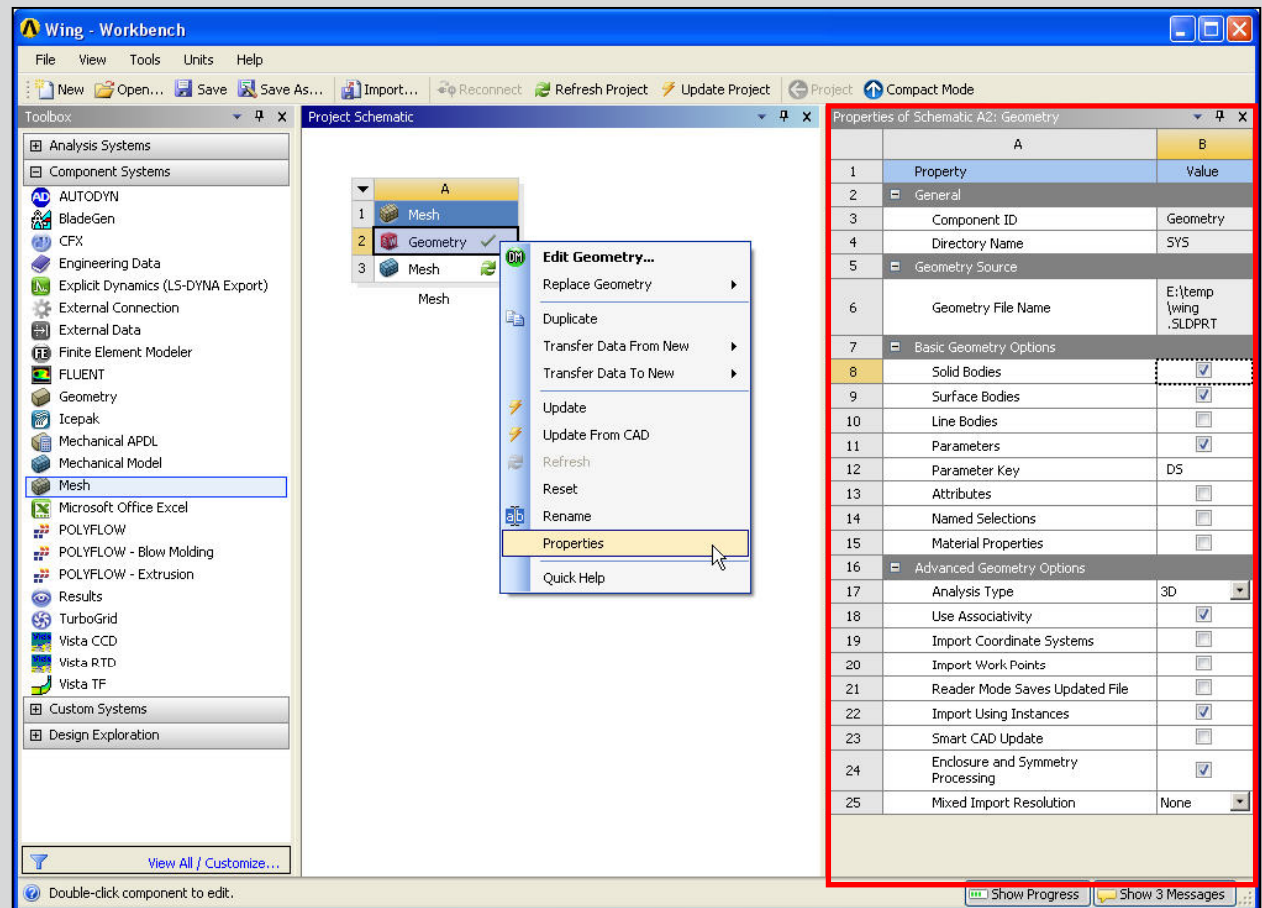


Geometry Properties (1)

- Right click **Geometry**
- Select **Properties**

Properties:

- Basic and Advanced Options
- Selected options under Advanced options are used while importing CAD geometry file in WorkBench



Geometry Properties (2)

Basic Properties :

- Select 'Parameters' option for importing parameters defined in CAD package
- 'Parameter Key' filters the parameters from CAD that enter Workbench
- If 'Parameter Key' is not specified, all parameters from CAD enter Workbench
- Similarly, Named Selections key controls the selections from CAD entering WB

Properties of Schematic A2: Geometry		
	A	B
1	Property	Value
2	General	
3	Component ID	Geometry
4	Directory Name	SYS
5	Geometry Source	
6	Geometry File Name	E:\temp\wing.SLDPRT
7	Basic Geometry Options	
8	Solid Bodies	☒
9	Surface Bodies	☒
10	Line Bodies	☐
11	Parameters	☒
12	Parameter Key	DS
13	Attributes	☐
14	Named Selections	☒
15	Named Selection Key	NS
16	Material Properties	☐
17	Advanced Geometry Options	
18	Analysis Type	3D
19	Use Associativity	☒
20	Import Coordinate Systems	☐
21	Import Work Points	☐
22	Reader Mode Saves Updated File	☐
23	Import Using Instances	☒
24	Smart CAD Update	☐
25	Enclosure and Symmetry Processing	☒
26	Mixed Import Resolution	None

Geometry Properties (3)

Advanced Properties :

- Select 'Use Associativity' to establish association between CAD and WorkBench
- Import Coordinate Systems, Work Points, etc. defined in CAD
- Smart CAD Update :
 - If selected, changes made in other options get updated in the model

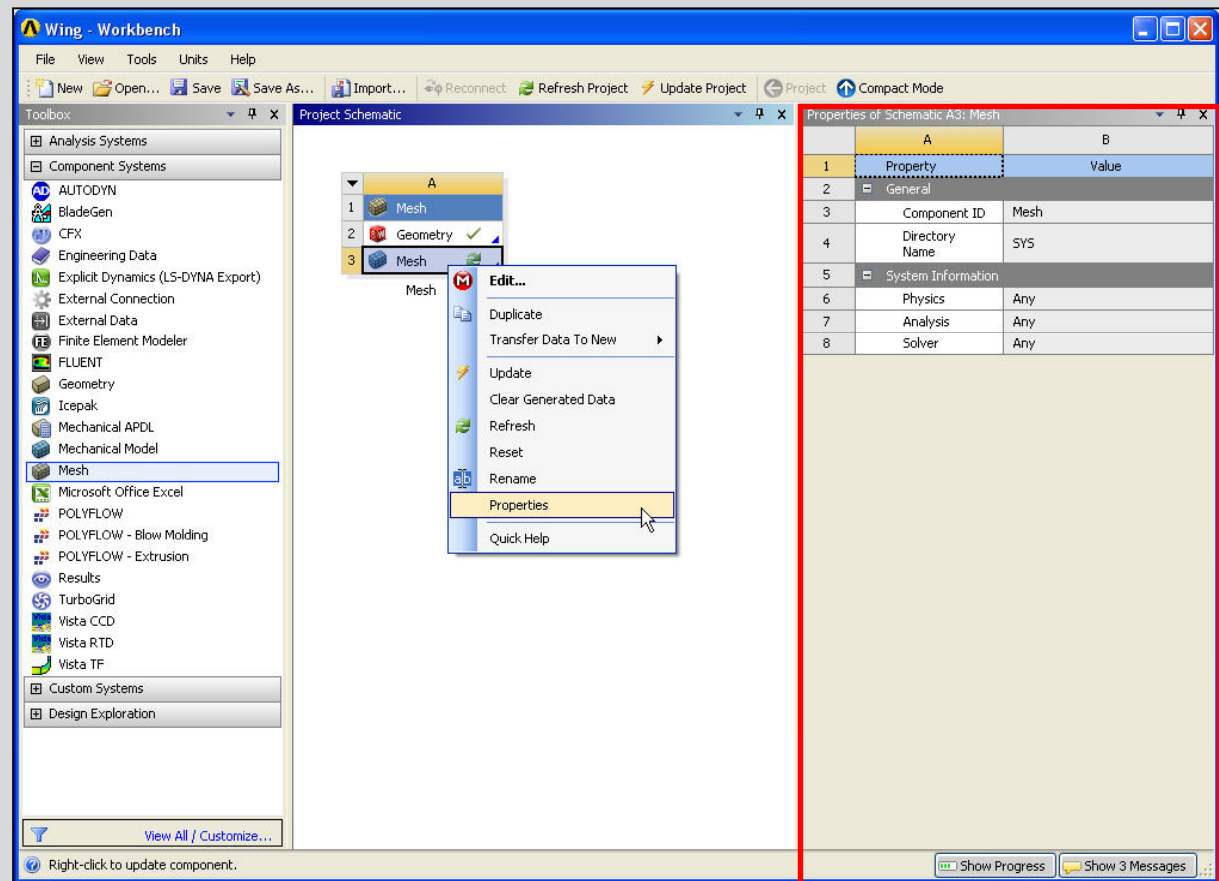
Properties of Schematic A2: Geometry		
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1	Property	Value
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7	Basic Geometry Options	
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9	Surface Bodies	☒
10	Line Bodies	☐
11	Parameters	☒
12	Parameter Key	DS
13	Attributes	☐
14	Named Selections	☒
15	Named Selection Key	NS
16	Material Properties	☐
17	Advanced Geometry Options	
18	Analysis Type	3D
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21	Import Work Points	☐
22	Reader Mode Saves Updated File	☐
23	Import Using Instances	☒
24	Smart CAD Update	☐
25	Enclosure and Symmetry Processing	☒
26	Mixed Import Resolution	None

Mesh Properties

- Right click **Mesh**
- Select **Properties**

Properties:

- General
- System Information :
 - Displays Physics, Analysis and Solver type for selected system
 - Information also available in Toolbox Customization panel



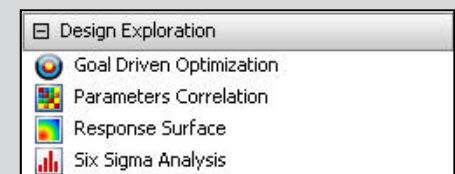
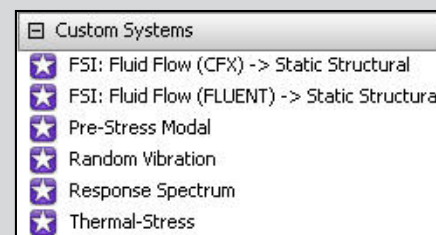
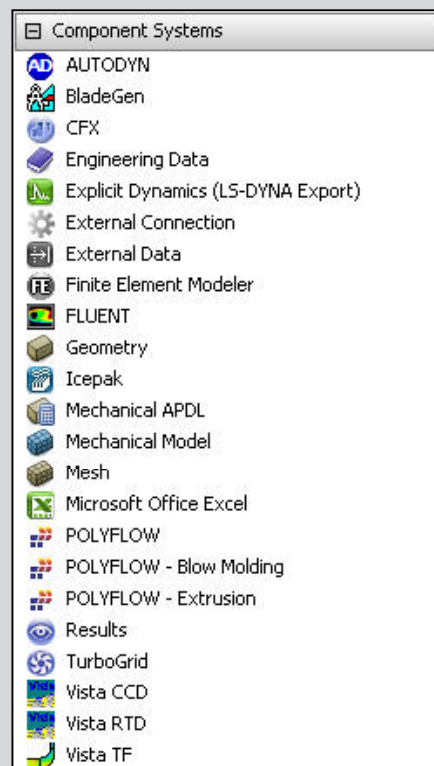
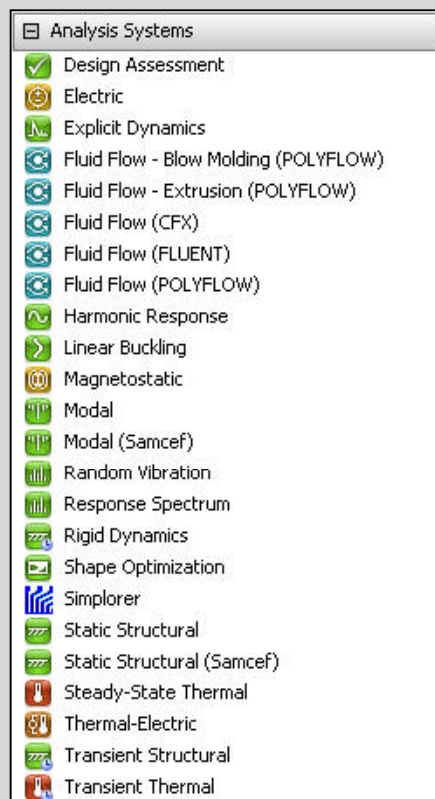
Appendix

Contents

- **Toolbox**
- **Type of Connectors**
- **Build Project Schematic : Example**
- **Menus**
- **Global Settings**
- **Parameters & Design Exploration**
- **Workbench Files Structure**



- Predefined Templates
- Individual applications to build or use Analysis Systems (AS)
- Predefined/user-defined AS for coupled applications
- Parametric management and optimization tools



Customize Toolbox

- Customize the number of tools available in the Toolbox

Ex: Default Systems under Component

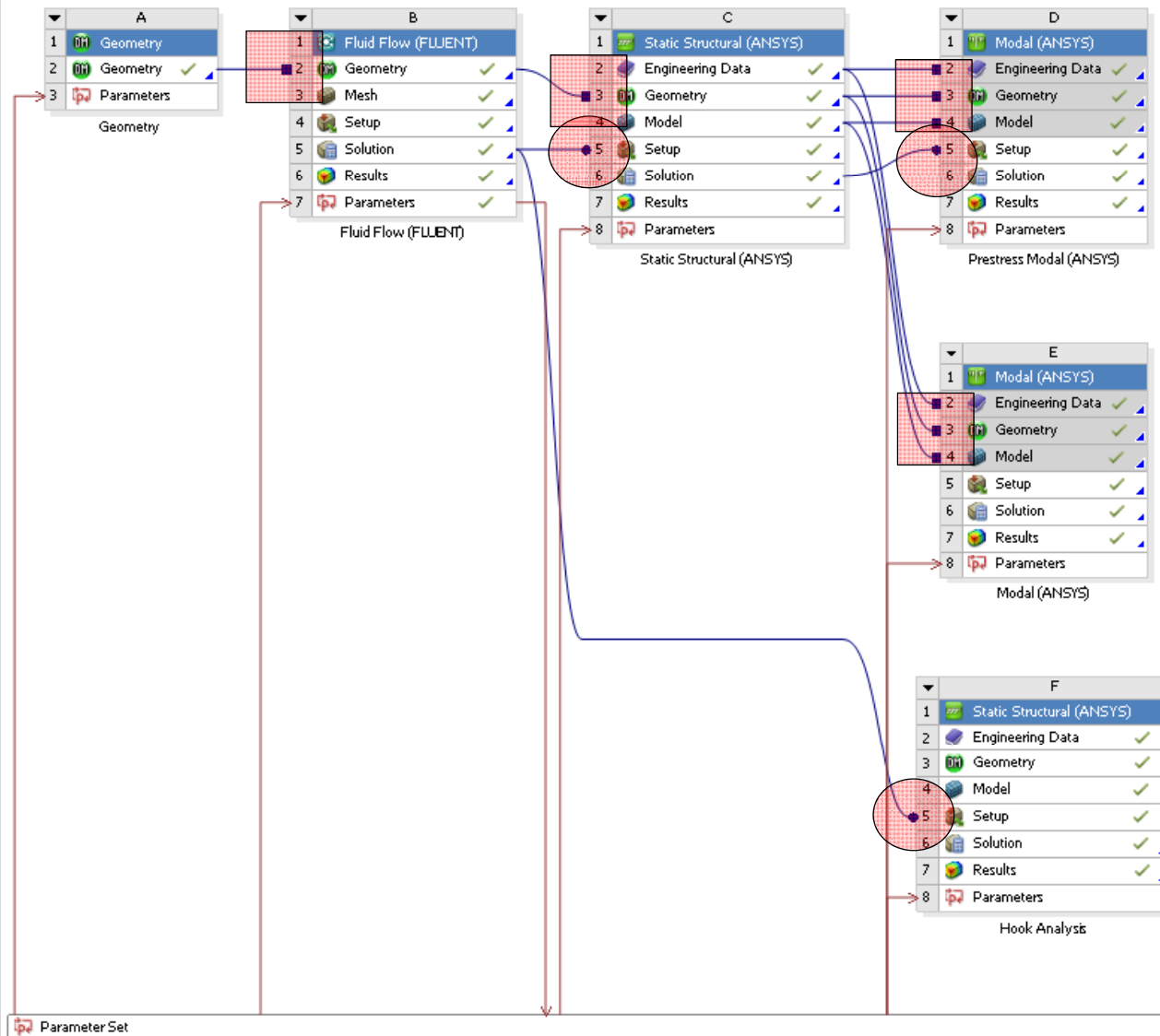
Component Systems		
	AUTODYN	
	BladeGen	
	CFX	
	Engineering Data	
	Explicit Dynamics (LS-DYNA Export)	
	External Connection	
	External Data	
	Finite Element Modeler	
	FLUENT	
	Geometry	
	Icepak	
	Mechanical APDL	
	Mechanical Model	
	Mesh	
	Microsoft Office Excel	
	POLYFLOW	
	POLYFLOW - Blow Molding	
	POLYFLOW - Extrusion	
	Results	
	TurboGrid	
	Vista CCD	
	Vista RTD	
	Vista TF	

Ex: Modified Component System

Component Systems		
	AUTODYN	
	BladeGen	
	CFX	
	Engineering Data	
	Explicit Dynamics (LS-DYNA Export)	
	External Connection	
	External Data	
	Finite Element Modeler	
	FLUENT	
	Geometry	
	Mechanical APDL	
	Mechanical Model	
	Mesh	
	Results	
	TurboGrid	

Toolbox Customization		
	Name	Physics
1	Analysis Systems	
2	Design Assessment	Customizable
3	Electric	Electric
4	Explicit Dynamics	Structural
5	Fluid Flow - Blow Molding (POLYFLOW)	Fluids
6	Fluid Flow - Extrusion (POLYFLOW)	Fluids
7	Fluid Flow (CFX)	Fluids
8	Fluid Flow (FLUENT)	Fluids
9	Fluid Flow (POLYFLOW)	Fluids
10	Harmonic Response	Structural
11	Linear Buckling	Structural
12	Magnetostatic	Electromagnetic
13	Modal	Structural
14	Modal (Samcef)	Structural
15	Random Vibration	Structural
16	Response Spectrum	Structural
17	Rigid Dynamics	Structural
18	Shape Optimization	Structural
19	Simplorer	Any
20	Static Structural	Structural
21	Static Structural (Samcef)	Structural
22	Steady-State Thermal	Thermal
23	Thermal-Electric	Electric
24	Transient Structural	Structural
25	Transient Thermal	Thermal
26	Component Systems	
27	AUTODYN	Explicit Dynamics
28	BladeGen	
29	CFX	Fluids
30	Engineering Data	Any
31	Explicit Dynamics (LS-DYNA Export)	Structural
32	External Connection	Any
33	External Data	Any
34	Finite Element Modeler	Any
35	FLUENT	Fluids
36	Geometry	Any
37	Icepak	Any
38	Mechanical APDL	Any
39	Mechanical Model	Any
40	Mesh	Any
41	Microsoft Office Excel	Any
42	POLYFLOW	Fluids
43	POLYFLOW - Blow Molding	Fluids
44	POLYFLOW - Extrusion	Fluids
45	Results	Fluids
46	TurboGrid	Fluids
47	Vista CCD	
48	Vista RTD	
49	Vista TF	Fluids
50		

Type of Connectors

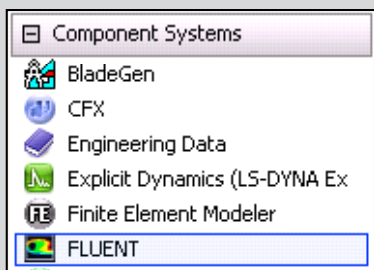


- Square connectors signify that the data is **SHARED** between the cells.

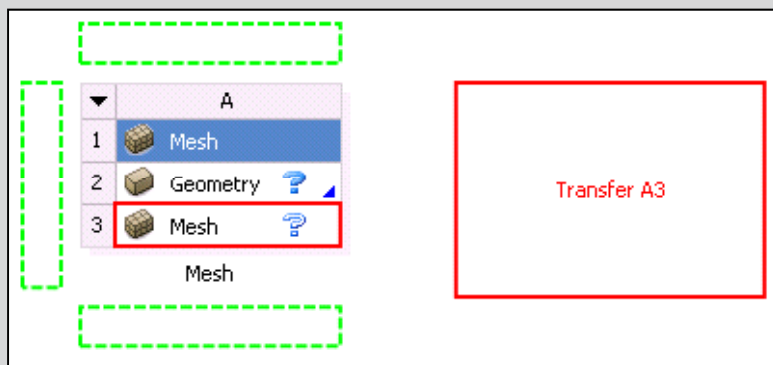
- Circular connector signify that the data is **TRANSFERRED** to new cell.

Build Project Schematic : Example

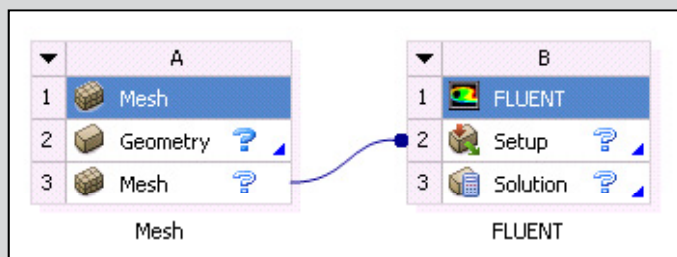
- Drag FLUENT component system onto an existing mesh component system



Step 1:
Select and Drag
FLUENT Component

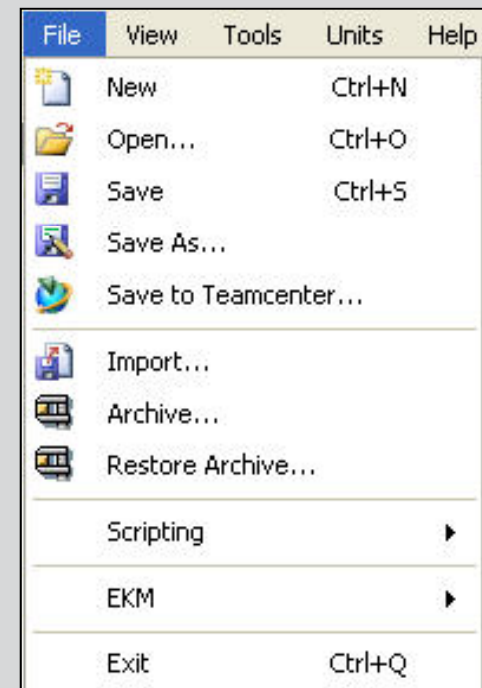


Step 2 :
Drop FLUENT
Component on Mesh



Connection is
established between
Mesh and FLUENT
setup

- Create/Open/Save a Workbench project file
- Saves data from all the components
- Import: Import files (for acceptable file types, see Import options)
- Archive: Quickly generate a single compressed file (.wbpz or .zip file) containing all pertinent files for easy transfer. Zipped file can be saved at any required location
- Restore Archive: Unzip and open zipped project files
- Scripting: Record and Run journal files
- EKM: Launch and connect to EKM i.e. Engineering Knowledge Manager

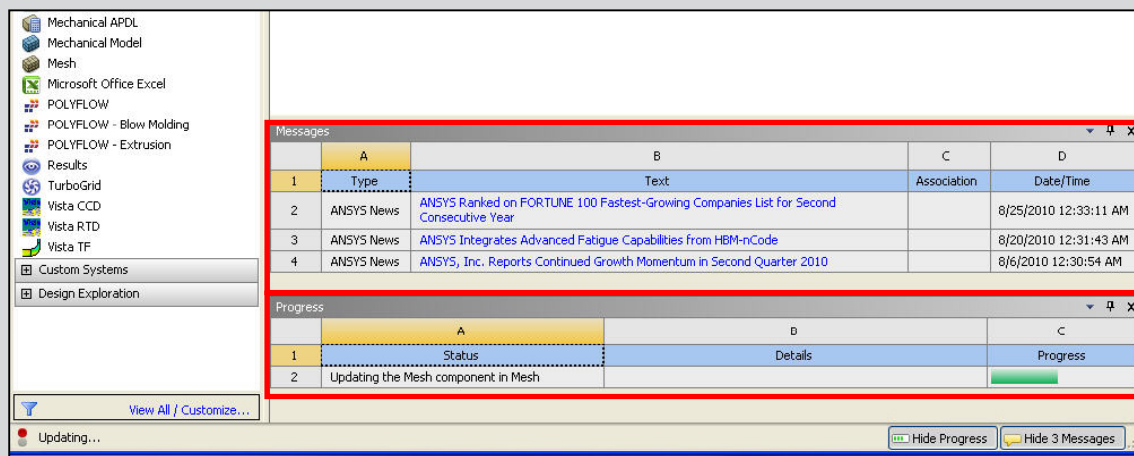


Workbench R10/11 Project (*.wbdb)
Simplorer Project File (*.asmp)
AUTODYN Save File (*.ad)
CFX-Pre Case File (*.cfx)
CFX-Solver Input File (*.def;*.mdef)
CFX-Solver Results File (*.res;*.bak;*.mres)
Importable Mechanical Files (*.dsdb;*.mechdat)
Engineering Data File (*.xml;*.engd)
BladeGen File (*.bgd)
Importable Mesh Files (*.cmdb;*.meshdat)
Geometry File (*.sat;*.sab;*.agdb;*.model;*.dly;*.CAT)
FEModeler Database (*.fedb)

WB Import options

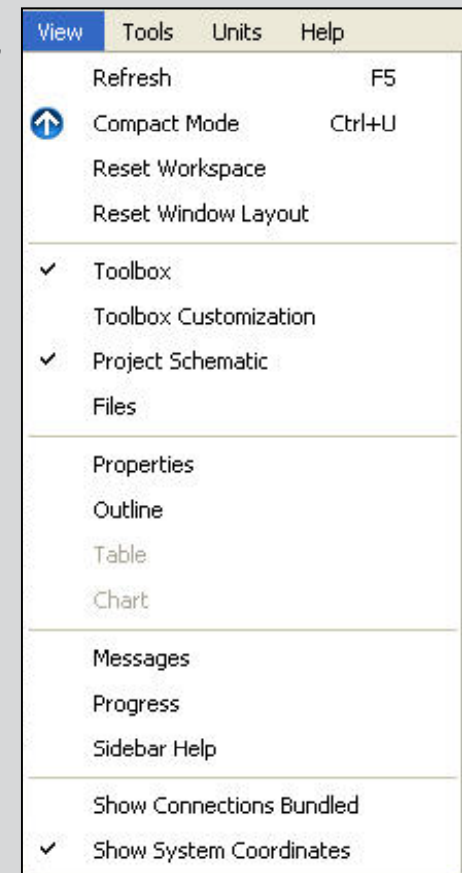
View Menu

- Refresh and Reset Window layout
- View Toolbox, Toolbox Customization, Project Schematic, Messages, Progress , etc. windows on Project page
- Reset Workspace restores current workspace to default settings
- Reset Window Layout restores original window layout



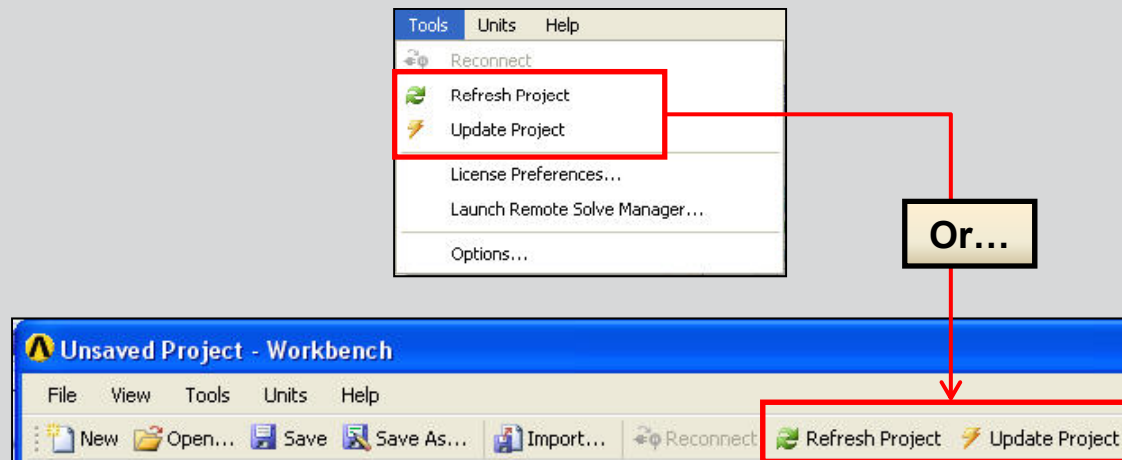
Messages

Progress



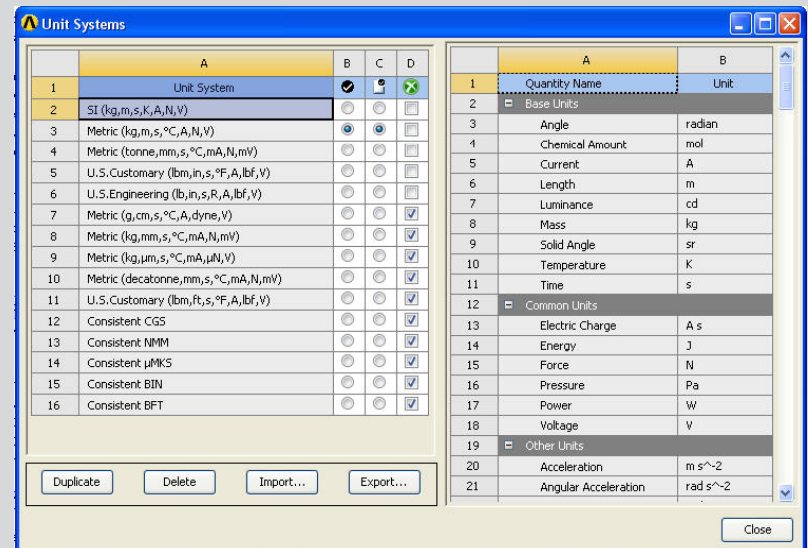
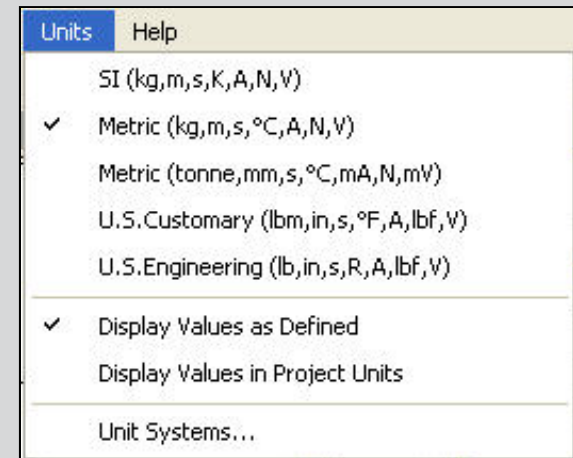
Tools Menu

- Refresh or Update entire project
- Modify Global Settings through 'Options ...'



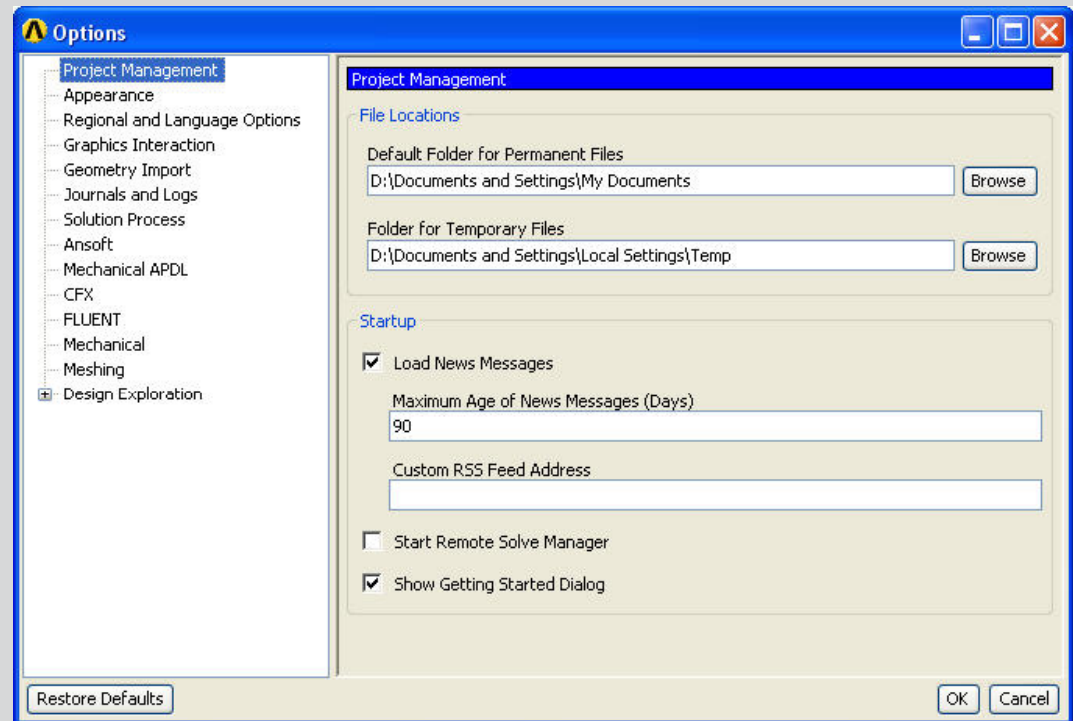
Units Menu

- Select Unit System to be used for the project
- Sets the default unit system for all systems
- Units can be changed within components like DM, AMP
- Display Values as Defined : displays value and unit as defined in Workbench or original source application
- Display Values in Project Units : displays values converted to selected project unit system
- Modify Unit Systems through 'Unit System ...'



Global Settings (1)

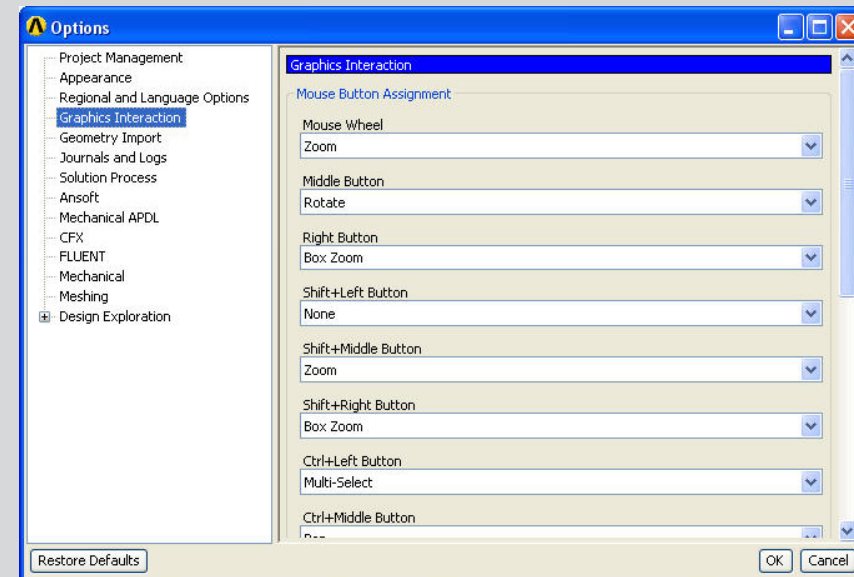
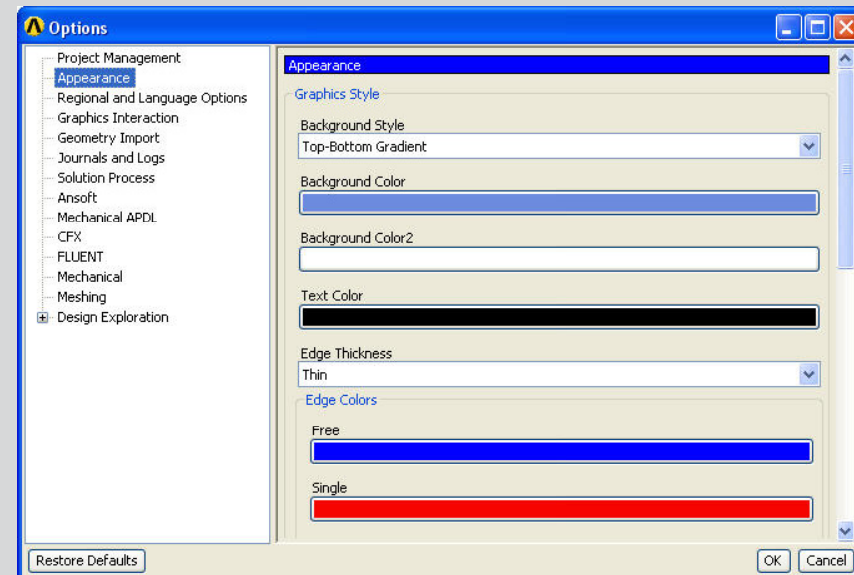
- Tools → Options ...
 - Project Management :
 - Manage File Locations
 - Manage Startup options



Global Settings (2)

- Appearance :
 - Manage Background Style, Color
 - Manage Display options

- Graphics Interaction :
 - Manage Mouse Button operations
 - Manage Keyboard Button operations



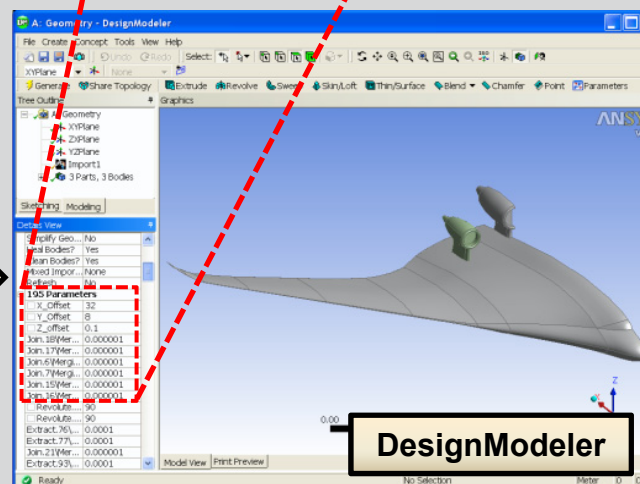
Importing Parameters : Example

CATIA V5

Parametric File

Parameters from
CAD to Workbench

Refresh	NO
195 Parameters	
X_Offset	32
Y_Offset	8
Z_Offset	0.1
Join.18/Mer...	0.000001
Join.17/Mer...	0.000001
Join.6/Mer...	0.000001
Join.7/Mer...	0.000001
Join.15/Mer...	0.000001
Join.16/Mer...	0.000001
Revolute...	90



DesignModeler

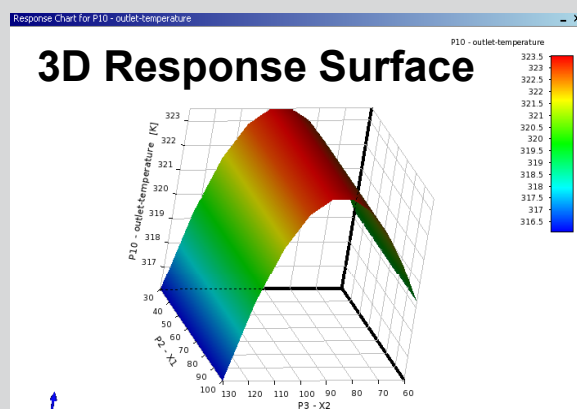
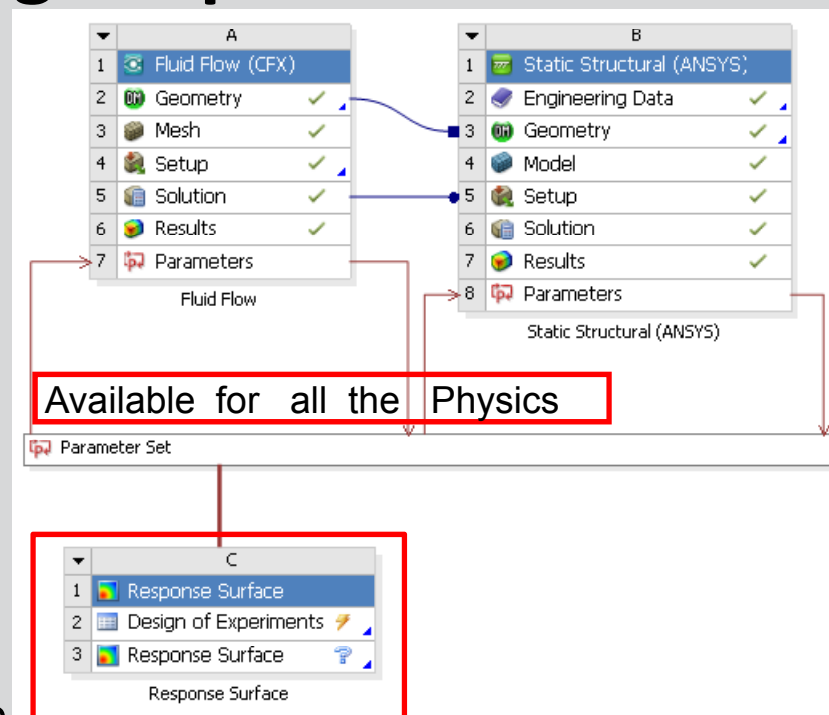
Parameters and Design Exploration

WB exposes and allows to manage the parameter at the project level

Parameter Set could be

- CAD parameters
- Geometry parameters set in DM
- Material parameters
 - Customization required
- Boundary condition parameters
- Result parameters
- And lot more

Details will be presented in a separate lecture

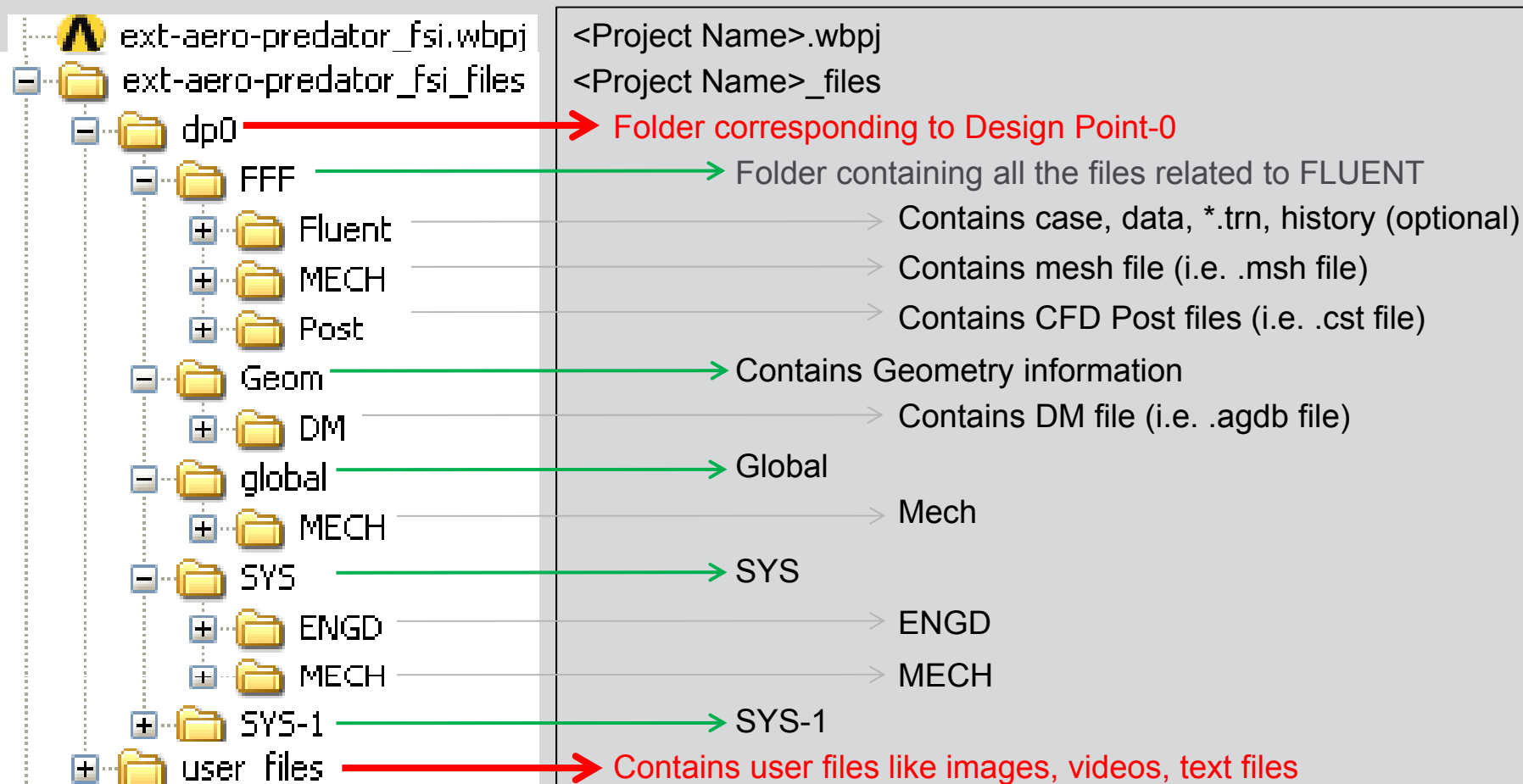


- Design Exploration tool allows you to
 - Create Parameter correlation
 - Create Response surface
 - Min-max search
 - Goal-drive optimization
 - Six sigma analysis
 - Direct optimization (Beta)

Workbench Files Structure (1)

- Workbench creates '<project>.wbpj' and a folder '<project>_files'
- All the project related files are saved within '<project>_files' folder

Here is an example showing folder structure of a multiphysics analysis project



Workbench Files Structure (2)

- When the project file (<filename>.wbpj) is created, ANSYS Workbench creates a project folder named <filename>_files
- All files relevant to the project are saved within project folder
- Primary subdirectories within project folder are:
 - dp0
 - user_files
- **dp0 subdirectory:**
 - Workbench designates active project as design point 0 and creates a dp0 subdirectory that always corresponds to active project files
 - Design point folder contains system folders for each system in the project
 - System folder contain folders for each application used in the system (i.e. Mechanical application, FLUENT, etc.)
 - These folders contain application-specific files and folders, such as input files, model directories, engineering data, resources, etc.
- **user_files:**
 - This folder contains any files (such as input files, referenced files, etc.) that are supplied to a project or any output (images, charts, movie clips, etc.) generated by Workbench