INCORPORATING WORKFLOW FOR V&V/UQ IN THE SANDIA ANALYSIS WORKBENCH
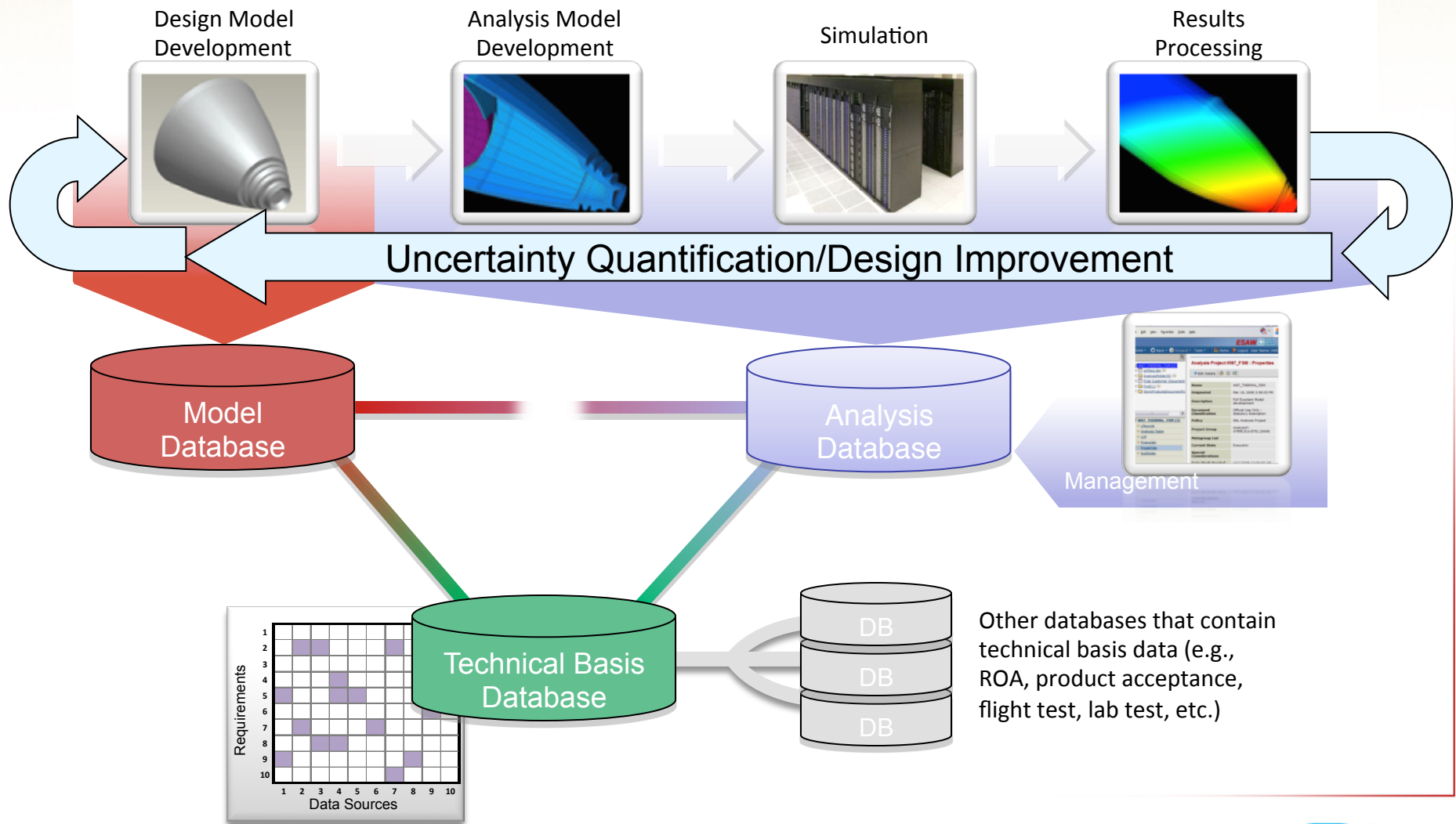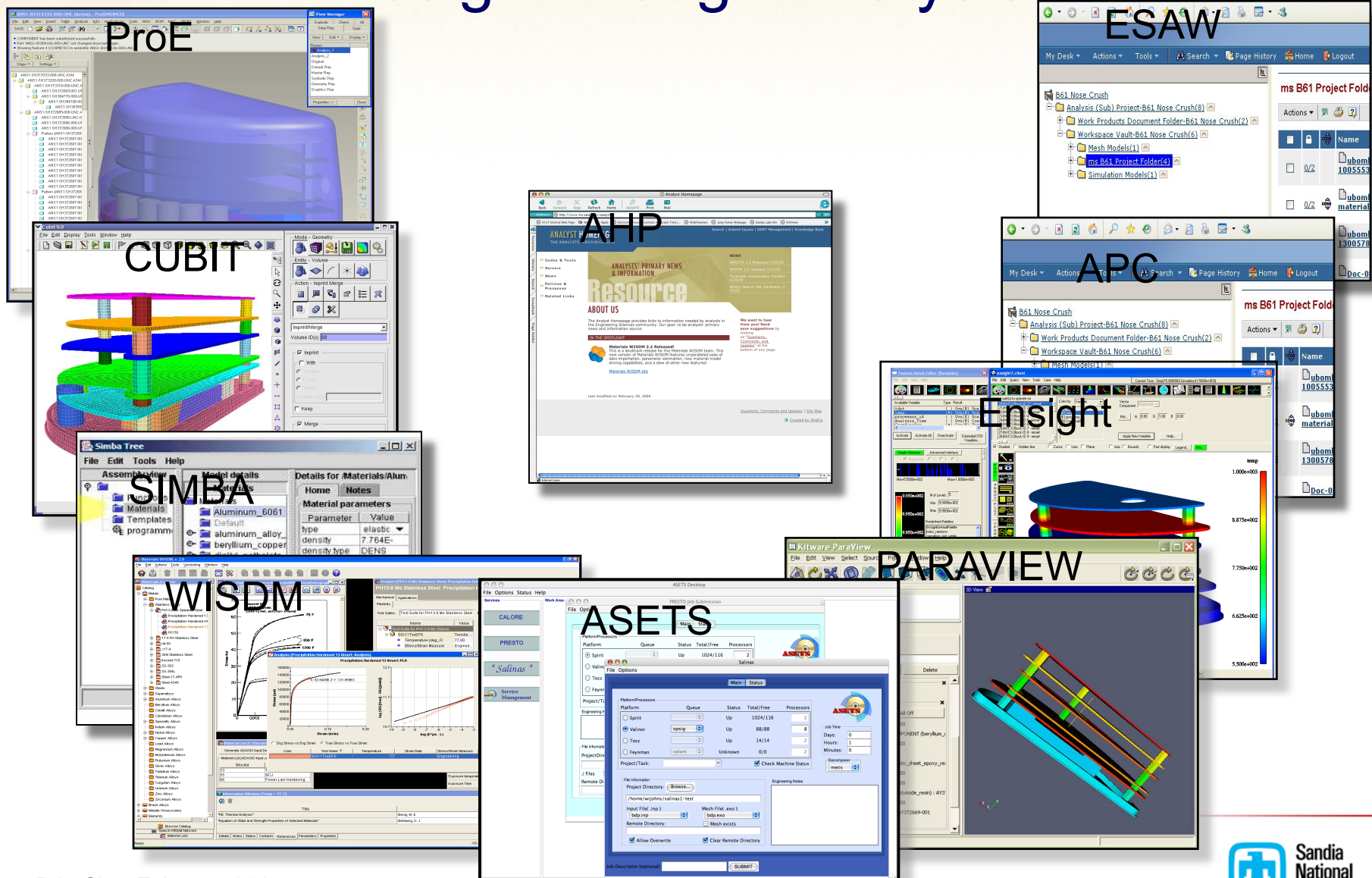
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Support the Design-To-Analysis process, capturing data in context

Design Model Development

Analysis Model Development

Simulation

Results Processing

Uncertainty Quantification/Design Improvement

Model Database

Analysis Database

Management

Technical Basis Database

DB
DB
DB

Other databases that contain technical basis data (e.g., ROA, product acceptance, flight test, lab test, etc.)

Requirements

Data Sources

SAND #2012-9091 C

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Pre-2010 – Federated Toolkit for Design through Analysis

ProE

ESAW

CUBIT

AHP

APC

Ensight

SIMBA

WISDM

ASETS

PARAVIEW

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Sandia Analysis Workbench

- The analysis process involves many (stove-piped) tools that generate a large number of artifacts, which must be managed by the analyst.

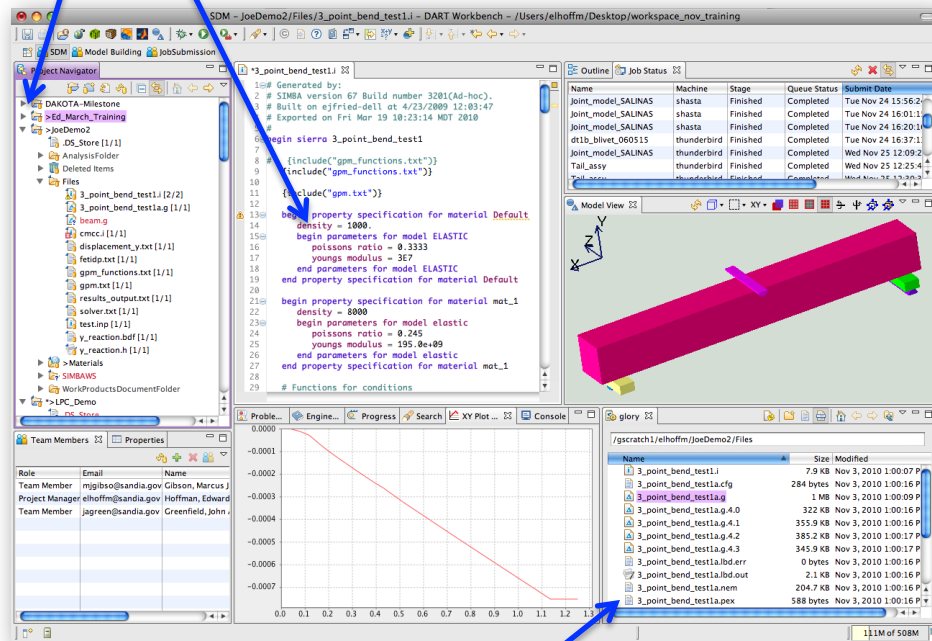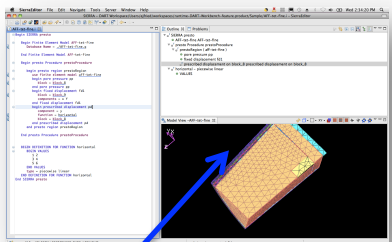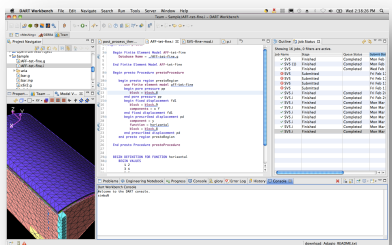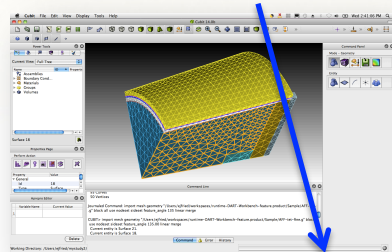- Vision: an integrated environment for these tools

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SAW provides a unified view of distributed enterprise resources on the desktop

Simulation Data Management

Model Assembly

Job Management

Multiple applications and tools combined into one, streamlining work and drastically reducing complexity

Teaming

Distributed File Management & Viz

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Metrics show widespread adoption of SAW

SAW Usage Metrics (Quarterly)
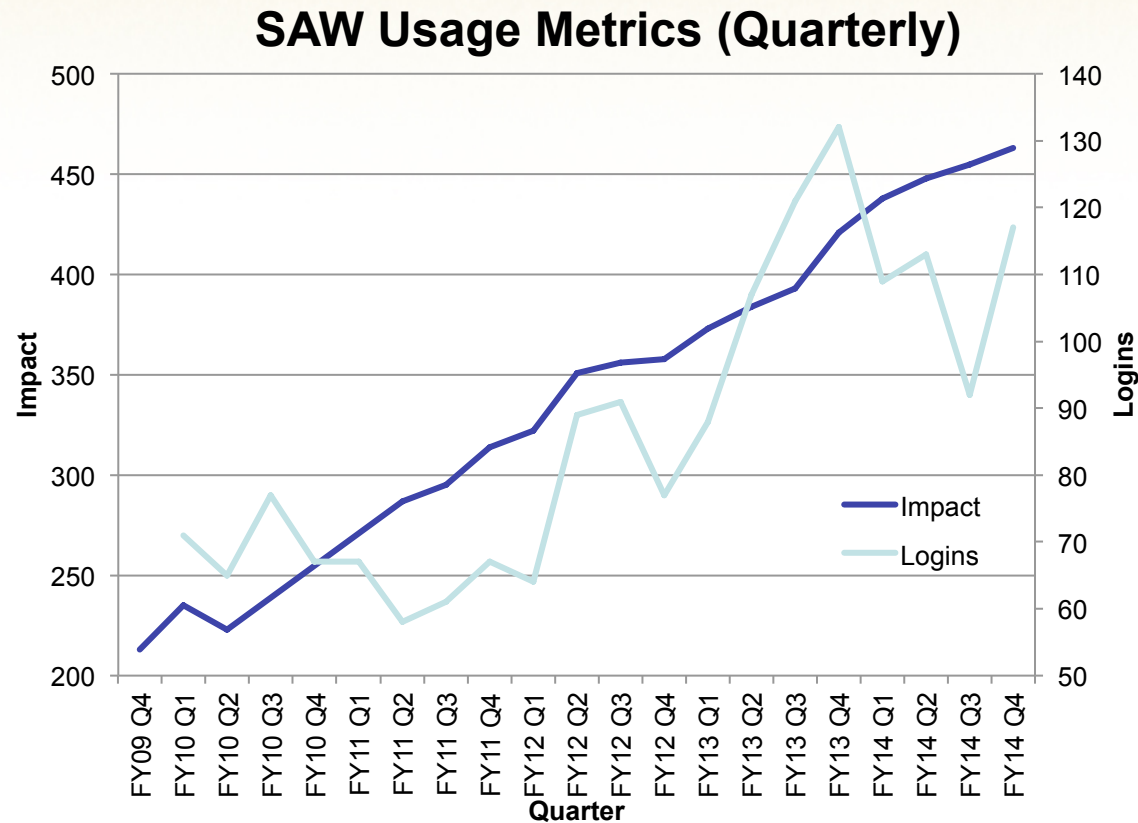
"Impact" represents staff who own data in our repositories
"Logins" are unique users of our data management service

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Adding Automated Workflow

- ## Workflow: a graph of connected nodes
  - Nodes represent activities
  - Arcs represent transitions, and may specify data interchange
  - There is a start and end node, and the start node may have preconditions
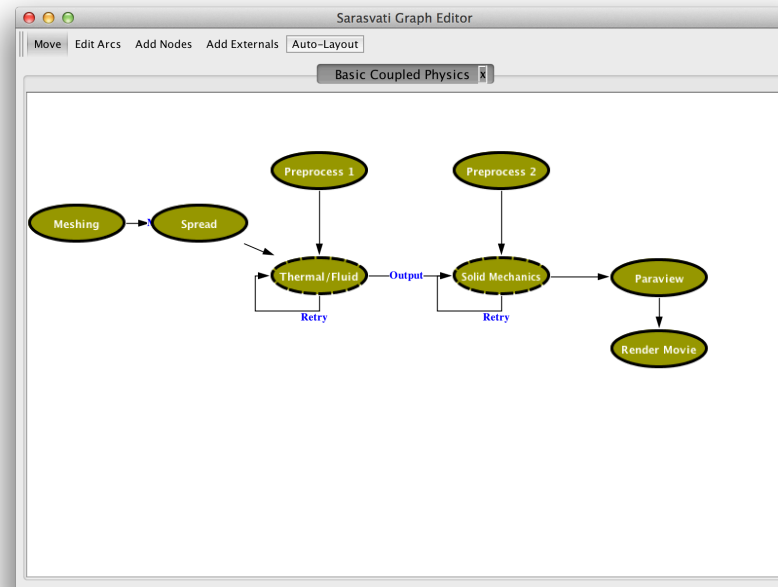
V&V of Workflows

- ## Complicated workflows are difficult to formally understand
  - Workflows may be converted to Petri Nets and formally proven
  - Provable workflows are an important aspect of V&V
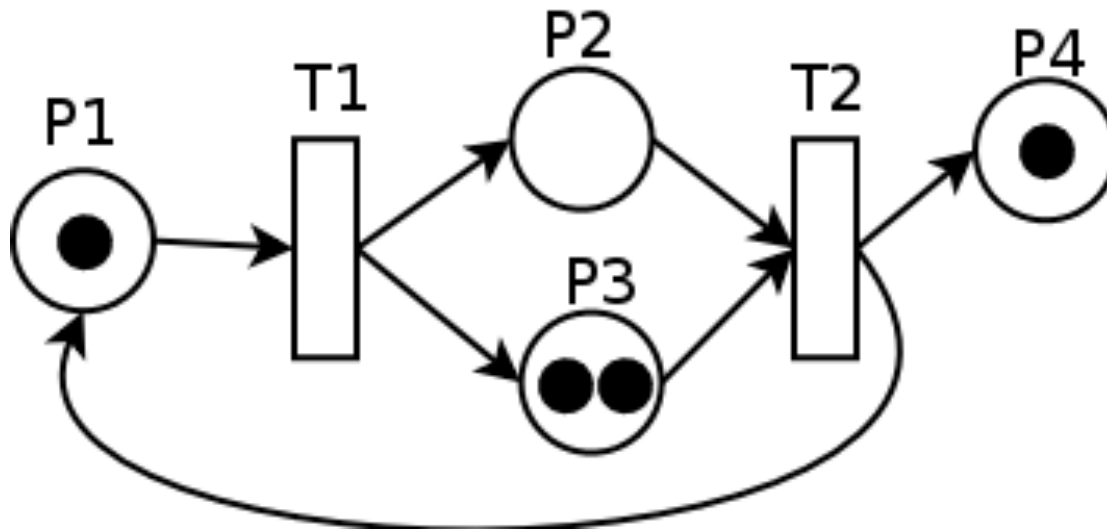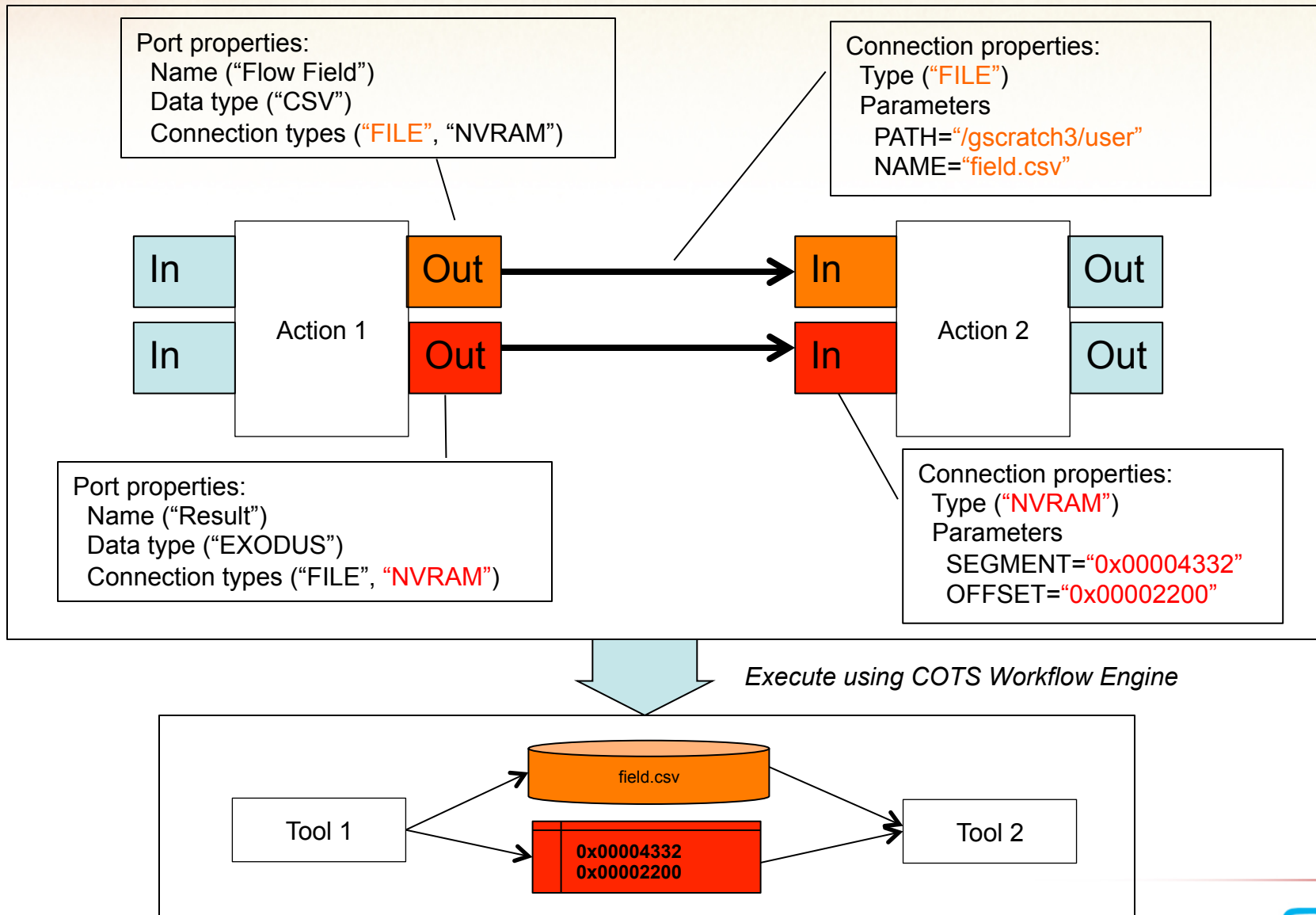
Workflow Execution

- ## Creates an auditable document trail
  - It is possible to data-mine workflows to ensure compliance as well as to identify opportunities for process improvement
  - Outputs may be captured and traceably related

- ## Re-execute at any time
  - Increased speed and reliability
  - Perform V&V sub-tasks when a prerequisite changes

- ## May become sub-workflows

Proposed Scalable Workflow Architecture Directly Connects HPC Codes Using Available Comms

Port properties:
Name ("Flow Field")
Data type ("CSV")
Connection types ("FILE", "NVRAM")

Connection properties:
Type ("FILE")
Parameters
PATH="/gscratch3/user"
NAME="field.csv"

Port properties:
Name ("Result")
Data type ("EXODUS")
Connection types ("FILE", "NVRAM")

Connection properties:
Type ("NVRAM")
Parameters
SEGMENT="0x00004332"
OFFSET="0x00002200"

Execute using COTS Workflow Engine

field.csv

0x00004332
0x00002200

Tool 1

Tool 2

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Current Status:
Automatic Workflow Generation

Tree View

Model Navigator

- CB_Params
  - Geometry/Mesh
    - Journal
    - Assemblies
    - Volumes
    - Groups
    - Blocks
    - SideSets
    - NodeSets
  - Sierra Solid Mechanics
    - Boundary Conditions
    - Constraints
    - Contact
    - Coordinates
    - Description
    - Failure Models
    - Finite Element Models
    - Functions
    - Initial Conditions
    - Loads
    - Materials
    - Output
    - Procedures
    - Regions
    - Rigid Bodies
    - Root
    - Sections
    - Solution Control
    - Solvers
  - Parameter Studies

Generated Workflow

Parameters

DAKOTA
(Studies/Optimization)

CUBIT → Sierra

Compute Jacobians | Extract Max Energy | Extract Max Displacement

Response computation actions

Generated workflows can be run in optimization loops or parameter studies using DAKOTA

User has a point and click interface to build workflow actions that extract common quantities of interest (no scripting needed)
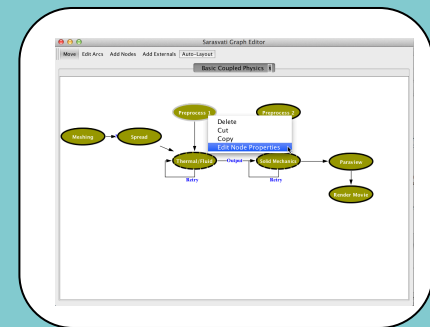
Sandia National Laboratories
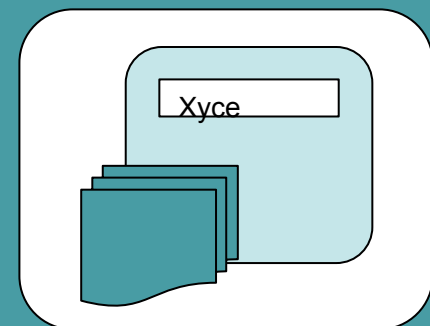
Implementing a Complete Workflow Capability

Finish full architecture implementation
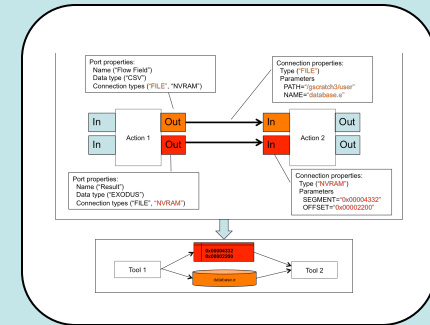
Add graphical workflow editor and visualizer

Add generic configurable workflow action for user codes

Xyce

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