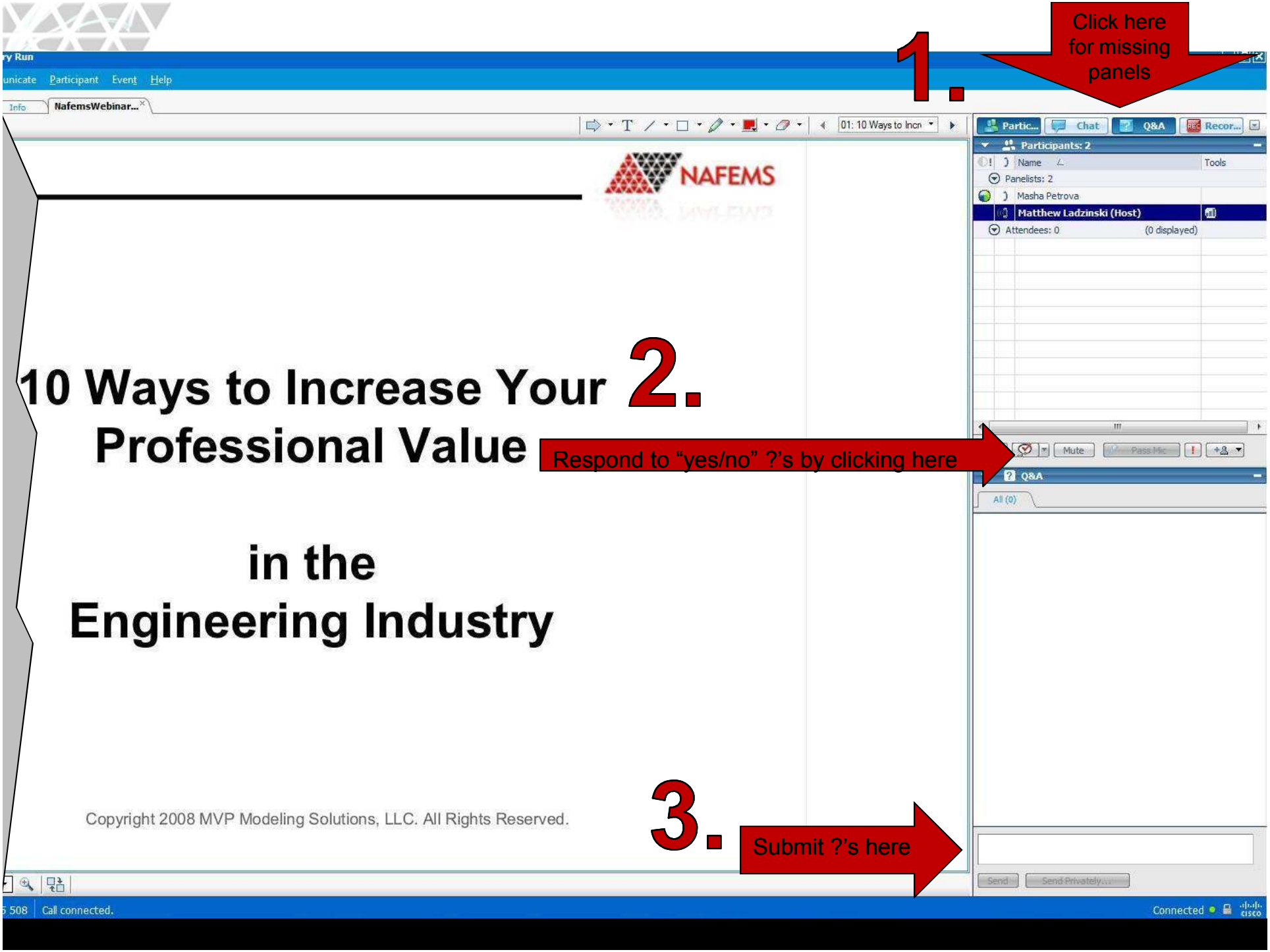
Contributing to the Bottom Line with Computer Modeling

September 2nd, 2009


1.
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NAFEMS
10 Ways to Increase Your Professional Value
2.
Respond to "yes/no" ?'s by clicking here
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Submit ?'s here
Participants: 2
Name
Tools
Panelists: 2
Masha Petrova
Matthew Ladzinski (Host)
Attendees: 0
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Agenda

Contributing to the Bottom Line with Computer Modeling

September 2nd, 2009

11am EDT (New York) / 4pm BST(London)

- Welcome & Introduction (Overview of NAFEMS Activities)
  - Mr. Matthew Ladzinski, *NAFEMS North America*
- Contributing to the Bottom Line with Computer Modeling
  - Dr. Masha V. Petrova, *MVP Modeling Solutions, LLC*
- Q&A Session
  - Panel
- Closing

Ladzinski

Petrova

THE INTERNATIONAL ASSOCIATION
FOR THE ENGINEERING ANALYSIS
COMMUNITY

An Overview of NAFEMS Activities

Matthew Ladzinski
NAFEMS
NAFEMS North America

Planned Activities

Webinars

- New topic each month!
- Recent webinars:
  - Composite FE Analysis
  - Dynamic FE Analysis
  - Modal Analysis in Virtual Prototyping and Product Validation
  - Pathways to Future CAE Technologies and their Role in Ambient Intelligent Environments
  - Computational Structural Acoustics: Technology, Trends and Challenges
  - FAM: Advances in Research and Industrial Application of Experimental Mechanics
  - CCOPPS: Power Generation: Engineering Challenges of a Low Carbon Future
  - Practical CFD Analysis
  - Complexity Management
  - CCOPPS: Creep Loading of Pressurized Components – Phenomena and Evaluation
  - Multiphysics Simulation using Implicit Sequential Coupling
  - Applied Element Method as a Practical Tool for Progressive Collapse Analysis of Structures
  - A Common Sense Approach to Stress Analysis and Finite Element Modeling
  - The Interfacing of FEA with Pressure Vessel Design Codes (CCOPPS Project)
  - Multiphysics Simulation using Directly Coupled-Field Element Technology
  - Methods and Technology for the Analysis of Composite Materials
  - Simulation-supported Decision Making (Stochastics)
  - Simulation Driven Design (SDD) Findings

To register for upcoming webinars, or to view a past webinar, please visit: www.nafems.org/events/webinars

- Established in 2009
- Next courses:
  - Dynamic FE Analysis – October 6th, 2009 (six-week course)
  - Composites – November 24th, 2009 (four-week course)
- Proposed course offerings:
  - Stochastics – Fall/Winter 2009
- For more information, visit: www.nafems.org/e-learning

Planned Events

Upcoming Nafems Events

Introduction au Calcul de Structures, aux Éléments Finis et à la Simulation Numérique
9th Jun 2009
Course
Paris,France

NAFEMS World Congress 2009
16th Jun 2009
Congress
Crete,Greece

Dynamic FE Analysis
30th Jun 2009
e-Learning
USA,Online

Practical Stress Analysis & Finite Element Methods
15th Sep 2009
Course
Midlands,UK

Dynamics Testing & Analysis Workshop
16th Sep 2009
Workshop
Bristol,UK

- Let us know if you would like to schedule an on-site training course (*see Introduction to FEA Analysis*)

Introduction au Calcul de Structures, aux Éléments Finis et à la Simulation Numérique
22nd Sep 2009
Course
Paris,France

Analisi del comportamento a crash mediante test virtuale
22nd Sep 2009
Seminar
Bologna,Italy

Introduction to FEA Analysis
22nd Sep 2009
Course
Orlando, FL,USA

Recent Advances in the Fatigue Analysis of Welded Structures
7th Oct 2009
Seminar
Gaydon,UK

Introduction to FEA Analysis
3rd Nov 2009
Course
Seattle, WA,USA

Multidisziplinäre Simulationen
9th Nov 2009
Seminar

- Multiple opportunities to attend conferences, seminars/workshops and training courses...

About Dr. Masha V. Petrova

- Founder and CEO of MVP Modeling Solutions
- Received Ph.D. from the University of California at San Diego - “Detailed and reduced chemical-kinetic descriptions for hydrocarbon combustion” under Prof. Forman A. Williams
- Worked as Development Engineer at Reaction Design
- Transitioned to sales and marketing, designed CHEMKIN training curriculum, led competition analysis initiative on various software
- Created and taught courses on the computer simulation of reactive flows and trained professionals all over the globe, including the USA, Canada, China, Japan and Germany
- Tour Speaker for the American Chemical Society Speaker Service
- Featured instructor for the American Chemical Society courses

Contributing to the Bottom Line with Computer Modeling

NAFEMS Webinar

September 2nd, 2009

Overview

- Importance of engineering computer modeling current economic environment
- Saving time and money with computer simulation
- How NOT to use simulation software tools
- Step-by-step process for successful implementation of a computer model into project workflow
- How to get more funding for your project - Presenting simulation results to upper management (the right way!)
- Discussion / Q&A

Importance of Computer Modeling in the Current Economy

Saving Money and Time with Computer Modeling

- Engineering computer modeling:
  - Saves company $$$$
  - Saves time, so you can focus on innovation and developing better products
  - Promotes creativity, innovation and product quality
  - Unavoidable
    - Companies that are broadening their simulation programs now, will be miles ahead in years to come

Saving Money

- Companies everywhere are slashing budgets
- But truly successful companies are increasing their engineering simulation budgets
- Because money saved by running simulations greatly off-sets any costs of having those programs in place

Why Computer Modeling

- Computer modeling and simulation will be unavoidable in the future
- Potential to save companies a lot of money
- Opportunity to help companies create much more innovative products, not possible in a lab

Why Companies Need A Computer Modeling Plan

- Are you convinced that computer modeling is essential to your engineering research?
- Are you sure that you are using the best software tools available?
- Does your upper management clearly understand how your modeling results can help create better products?
- If the answer is NO or MAYBE to any of these questions, you need to re-think the way your organization is running computer experiments

Reactive Flows

- Anything that flows (liquids, gases, plasmas) and chemically reacts
- Auto and aero fuels, catalysis, reactions on material surfaces, combustion engines, turbines, oil and gas, microelectronic processes, etc
- Out of FEA, CAD, CFD – probably the most complex process to model

What is the Purpose of Engineering Software?

The purpose of modeling software is to solve (or approximate and solve) the set of appropriate governing equations

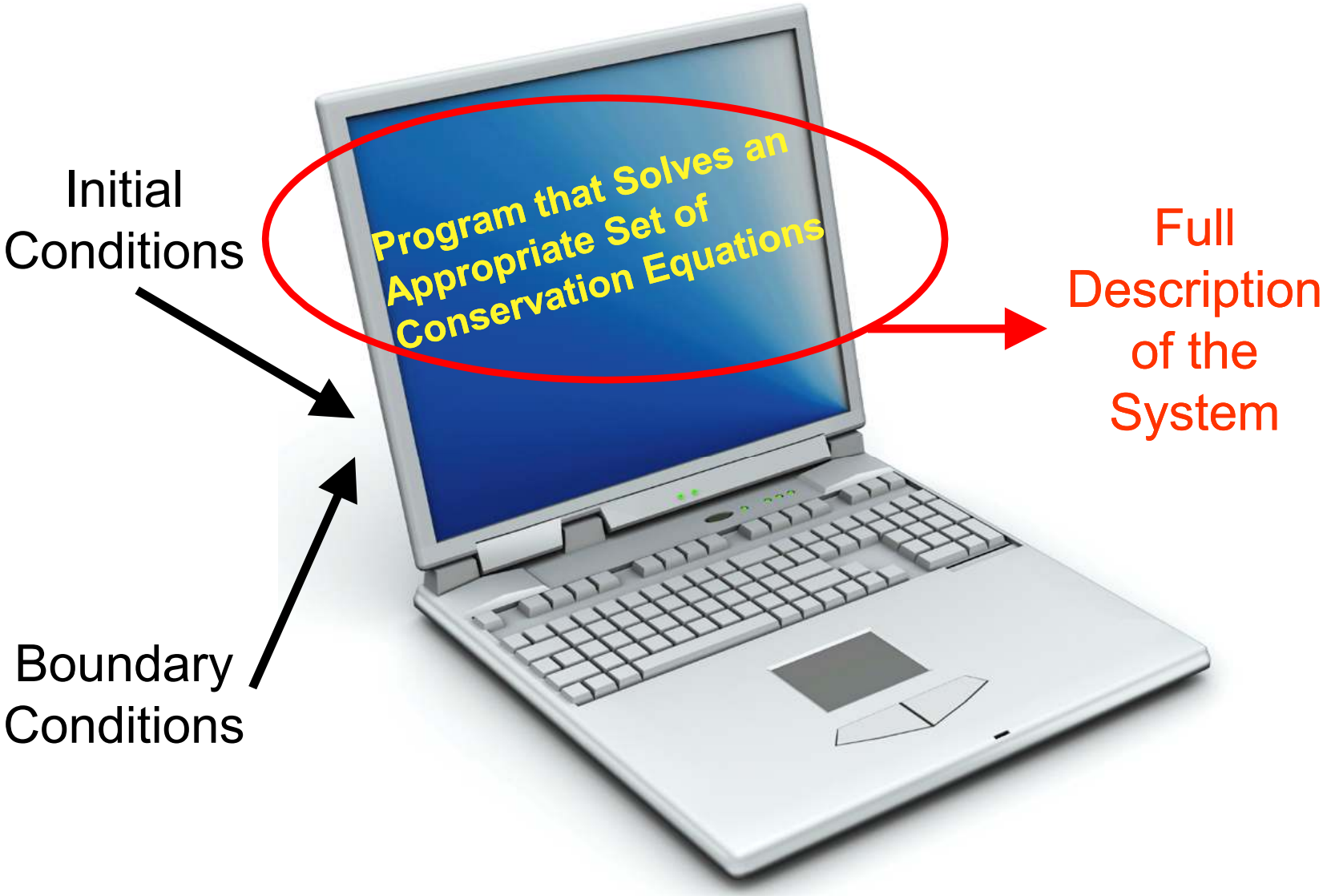
Governing Equations

- CFD - The Navier-Stokes equations (for a viscous, heat conducting fluid)
- Reactive Flows - Navier-Stokes equations + species equations
- FEA- Approximated PDEs and solves resulting equations

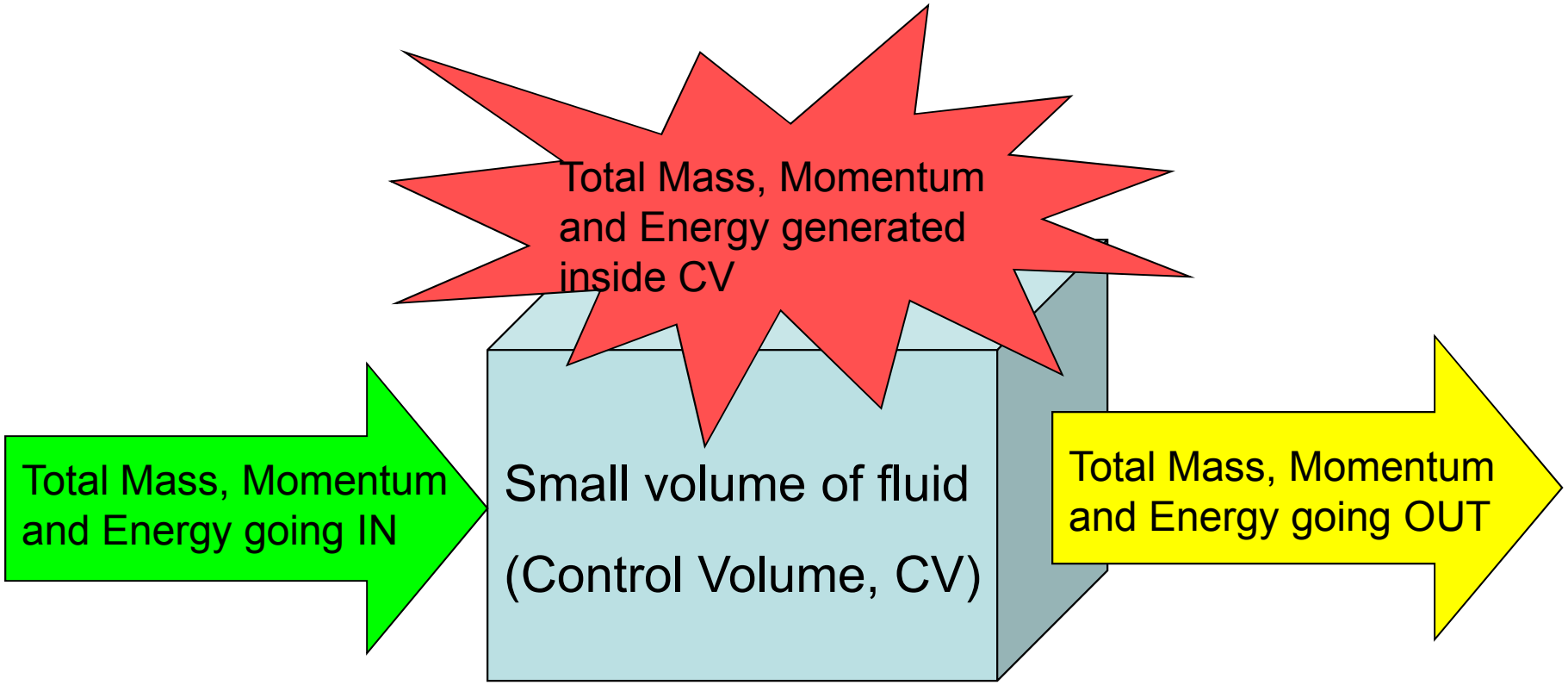
Why Solve Equation Set?

- If you can solve the set of particular Governing Equations, you can determine the value of each unknown variable in the equation set

- Thus completely describing your engineering system at each time and space point



Conservation Equations describe what goes IN and OUT of the System and what is Generated inside the System

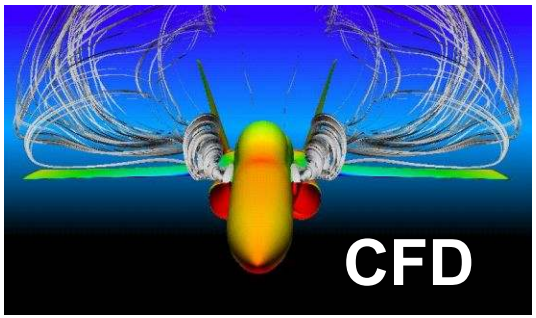


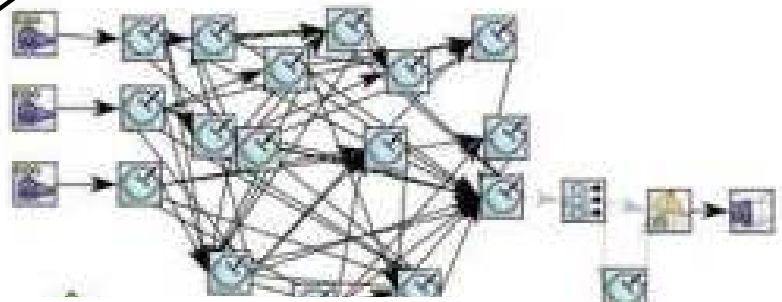
Note on Reactive Flows
Detailed vs. Reduced chemistry

- Reactive Flow conservation equations also require calculating reaction rates, which in turn require reaction rate constants (which are inputs from the user)
- More reactions you have, more accurate is the calculation of the chemical source term and thus the overall result
- Less reactions (reduced mechanism), less accurate source term, faster calculations.

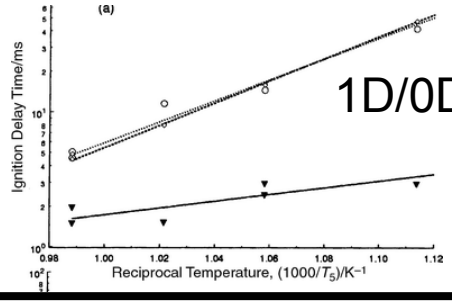
Current Modeling Dilemma for Reactive Flows (1)

The Real World





Reactor Networks



1D/0D Codes

Geometric Complexity

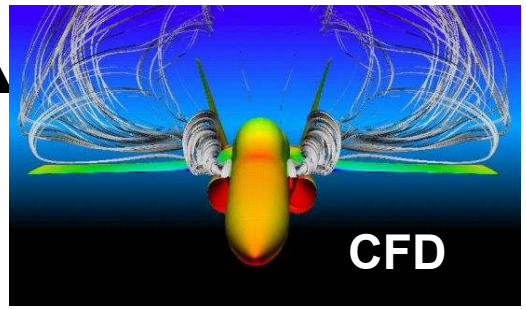
Chemical Accuracy

MVP Modeling Solutions

NAFEMS

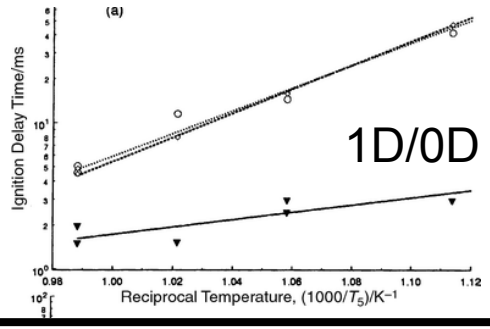
Perfect software tool

(currently non-existent)



Geometric Complexity

Reactor Networks



1D/0D Codes

Chemical Accuracy

So Why Bother with Simulations?

- Real world is not a simulation

- A LOT of real money and real time can be saved using the right combination of simulation tools and expert knowledge

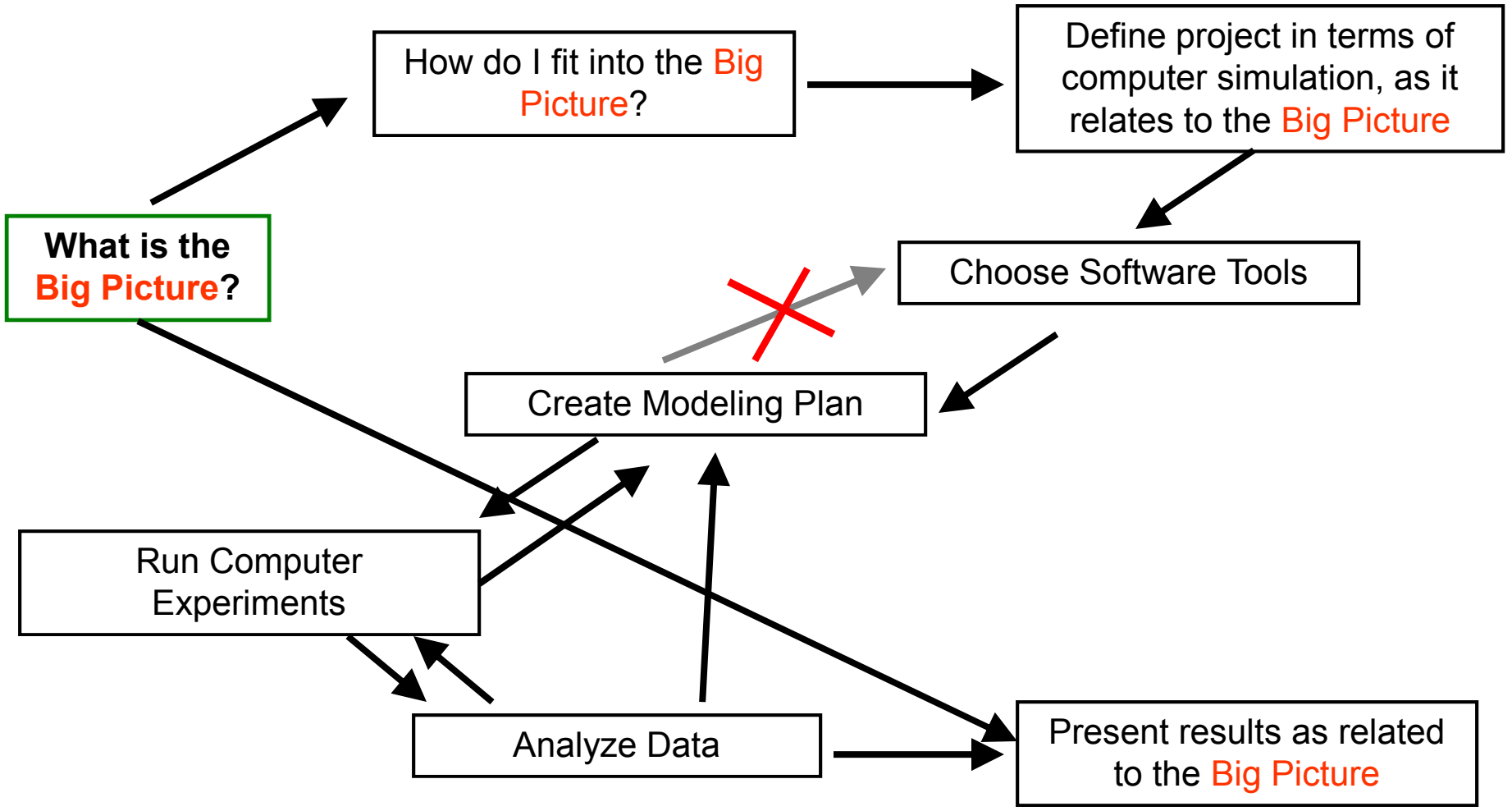
How NOT to Use Computer Modeling (1)

- Do not have a modeling plan ahead of time
- Run simulations only because everyone else is doing it
- Get free or cheapest software available
- Do not understand assumptions you have to make in your problem
- Do not understand assumptions that software tools are making

How NOT to Use Computer Modeling (2)

- Use inputs (temperatures, pressures, mechanisms turbulence) because it “feels” right or you don’t know what else to use
- Plug unreliable input variables, using incorrect assumptions, into unsupported freeware..
- Voilà!! Meaningless and useless results!

Implementing Computer Modeling Into Your Workflow



What is the Big Picture?

- What are your company's products?
- How does your company get revenue?
- Is your company presenting itself as innovative, environmentally friendly, profitable, other?

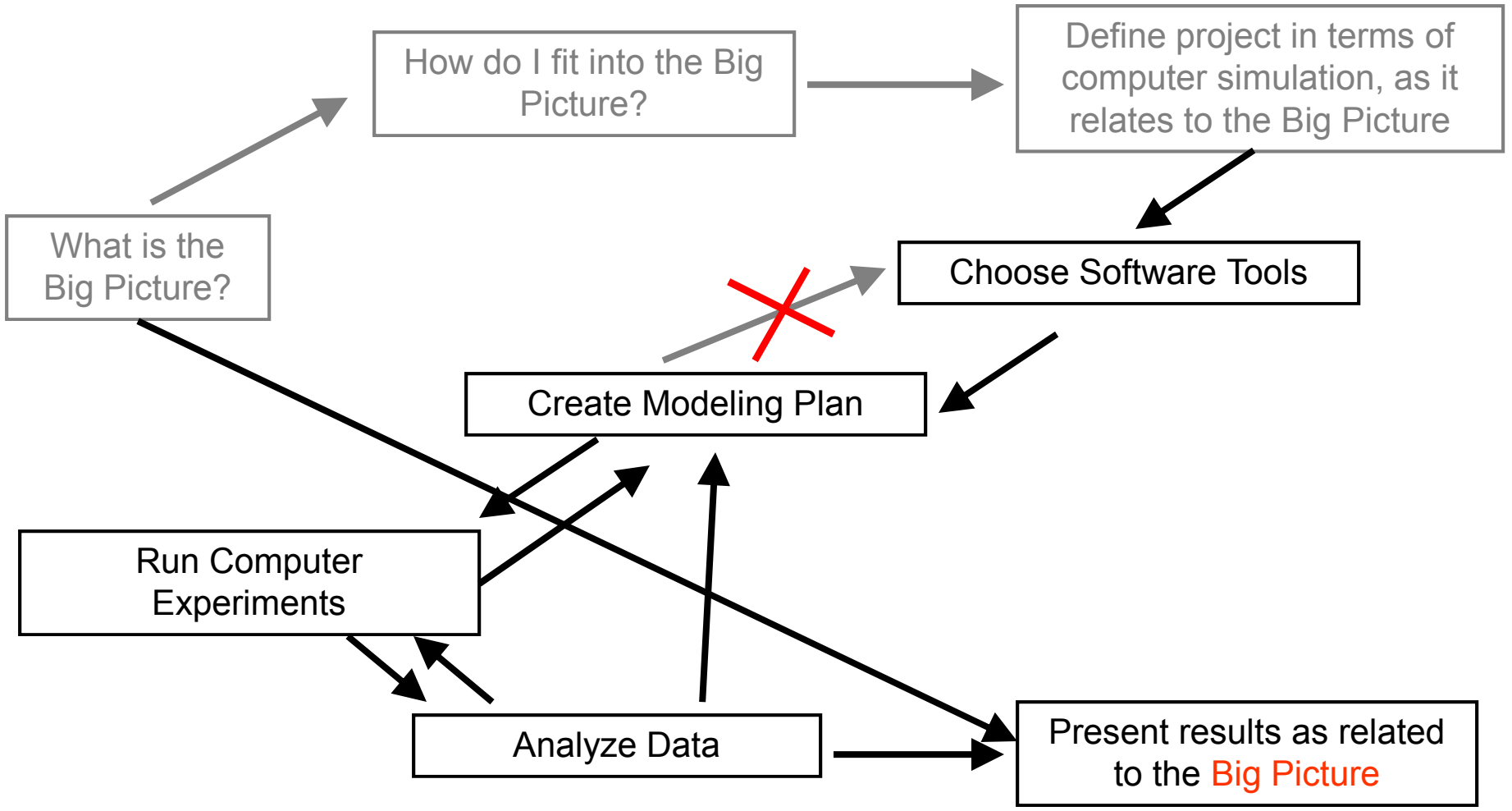
How do I fit into the Big Picture?

- How do I/my team contributes to company products / services?
- How does what I do help company image (my work is innovative, helps the environment, creates new products that bring in $$$)?
- How does my work help the bottom line (saves $$$ or brings in more revenue)?

Define Project in Terms of Computer Simulation

- Simulation Goal
- Variables that you can control or cannot control but need to take into consideration?
- Physical and chemical processes to consider
- Assumptions that can safely be made in order to achieve the goal
- Is it possible to model some physical and chemical processes separately?
- Pick the best software available for each separate process

Implementing Computer Modeling Into Your Workflow



Choose Best Software Available for Each Separate Process

- Personal software needs
  - Programming experience
  - Time, energy and expertise to program and compile code
  - Consider your budget
- Physical/chemical processes to model
  - How do these processes effect each other?
- What are the inputs to each software tool?
- What variables does the software need to calculate (outputs)?
- Assumptions that the software makes
- Company needs (commonly used platform, future projects, other groups)

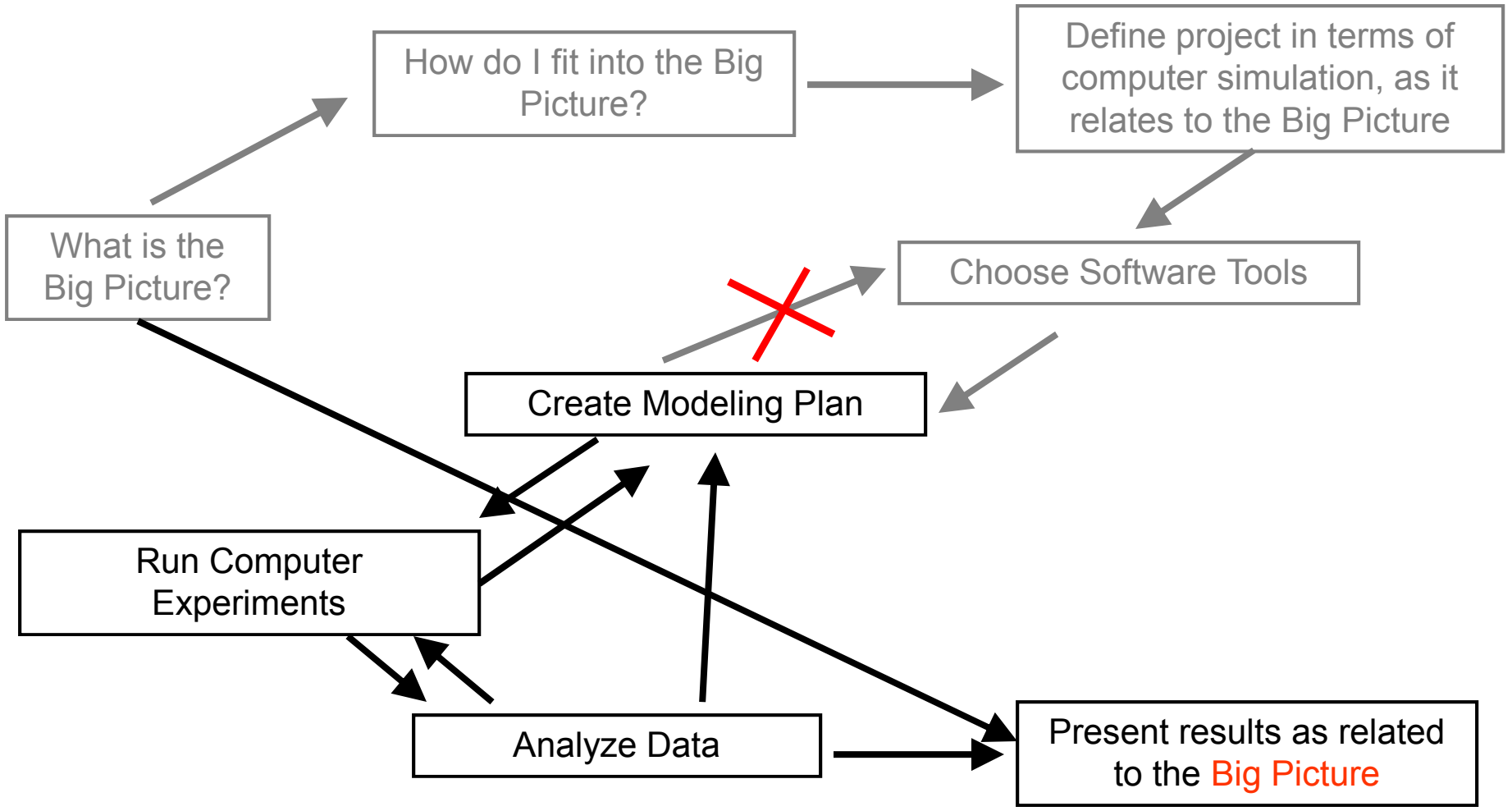
Create Specific Modeling Plan for Each Software Package

- List all of the specific inputs
- Create a matrix (or several) of experiments

Inputs				
Pressure	1 psi	5 psi	10 psi	100 psi
Temp	1000 K	1200 K	1500 K	2000 K
Reactant	0.01	0.1	0.5	2.0
…				
…				…

- Carefully record results
- Repeat the process (take results into account)

Implementing Computer Modeling Into Your Workflow



Presenting Simulation Results to Management

- **Always** relate the numbers to the Big Picture!!
- How is modeling saving $$$ or making $$$ for the company?
- How is it helping create more innovative, environmentally friendly, etc. products?

When Presenting Modeling Results- Remember!

- People running the company do not care that delta=0.001, or that you converted a code from Fortran to C++, or if computational results are close to experimental results
- They care about how you are contributing to the bottom line
- If you want funding for computer modeling research – show how modeling is contributing to the bottom line

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Q&A Session

Using the Q&A tool, please submit any questions you may have for our panel.

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Thank you!

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