Information Integration Technologies for Complex Systems

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Cast of Collaborators

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- Val Johnson
- Dave Higdon
- Mark McNulty
- Bruce Lettilier
- Tom Bement
- George Duncan
- Joanne Wendelberger
- Mike McKay
- Jerry Morzinski
- Max Morris
Problem is not Modeling, it is Decision Making

Optimal decision-making requires diversity of information:

- **Sources of information** - theoretical models, test data, computer simulations, expertise and expert judgment (from scientists, field personnel, decision-makers...)
- **Content of the information** - information about system structure and behavior, decision-maker constraints, options, and preferences...
- **Multiple communities/disciplines** that are stakeholders in the decision process.
“Multi-” vs. “Inter-” Disciplinary

• **Multi-Disciplinary** = People from different disciplines coming together to each do a separate part of a problem.

• **Inter-Disciplinary** = People from different disciplines having to integrate and synthesize their knowledge, understanding, skills, to solve a problem.

• Our interest is in the development of inter-disciplinary approaches for complex systems analyses

• The challenge = usually no tools or framework exists to facilitate Interdisciplinary work.
Where We Need to Go

**GOAL:** Develop frameworks of processes, methods, and tools useful for evolving R&D to support decision making under uncertainty, from basic science decisions to policy.

**COMMON PRACTICE:** Evolution of data, modeling, and analysis in a stovepipe manner within disciplines. Integration of the science occurs accidentally or through some "test" event or in the mind of the decision maker.
Complex System Modeling Process

Decision Context and Objectives

Iterative Problem Refinement

Problem Definition

Qualitative Models

Qualitative Quantitative mapping

Statistical Mathematical Models

Decision Making

Data Sources

Communities of Practice/Multiple Disciplines

Qualitative

Quantitative

mapping
Industrial Applications
Goals for Workshop

• Gain concrete understanding that all scientific discovery is a piece of something bigger

• Learn mechanisms and strategies for quick immersion into an interdisciplinary science
  – Can we quickly bring to bear and communicate our expertise about the complex system without having to become an expert in all of the other science areas?

• Discover the components of mathematical and statistical modeling of complex systems
  – Complex system representations
  – Data/information combination
  – Assessment
Workshop Outline

Greg: Mapping the Problem
Alyson: Statistical Models
Sallie: Assessment

Decision Context and Objectives

Iterative Problem Refinement

Problem Definition
Qualitative Models
Qualitative mapping
Statistical Mathematical Models
Data Sources

Communities of Practice/Multiple Disciplines

Andrew: System Representations