
Information Integration Technologies for Complex Systems

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Cast of Collaborators

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- Mike McKay
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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

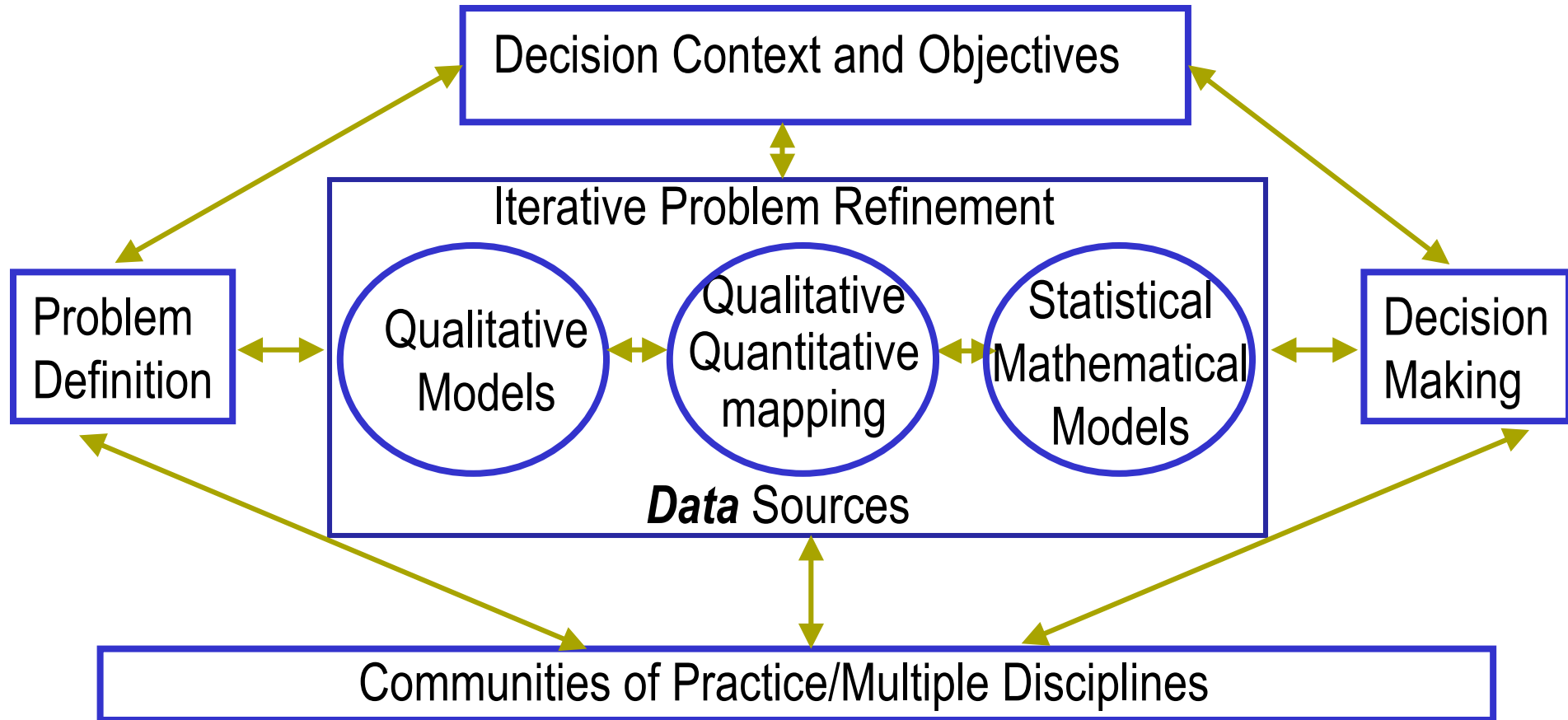
Where We Need to Go

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



Industrial Applications



PowerFactorE
A Suite of Reliability Engineering Tools for Optimizing the Manufacturing Process

Procter & Gamble and Los Alamos National Laboratory
 2003 R&D 100 Joint Entry

Predicts, prevents and reduces equipment failures

The Hazard Rate Plot, $\lambda(t)$, The Bath

Improves bottom-line results through higher reliability

Improves product quality

Increases throughput

Provides a unique, system-wide approach

Reduces operating and capital expenses

2003



Automotive Systems

Driving Tomorrow's Technology



PREDICT—A New Approach to Product Development

Los Alamos National Laboratory and Delphi Automotive Systems

Forecasts product performance before prototyping

Identifies flaws before costly production decisions

Provides road map for tests and design improvements

Directs elicitation of expert knowledge

2000



Ideas That Change the World



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

Andrew: System Representations

Alyson: Statistical Models

Sallie: Assessment

