Rapidly-Deployable Decision Support
for Decision Making Under Deep Uncertainty
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Most Pressing Policy Challenges Exhibit Deep Uncertainty

- Uncharacterizable uncertainty about future conditions
- Multiple competing objectives
- Highly complex, inter-related, and often poorly understood systems

www.wucaonline.org

www.ecoecokosoy.com/lab-news

blog.scalyr.com

2
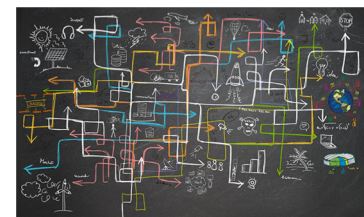
Good Decisions Tend to Emerge from Processes in Which People Are:

- Explicit about their goals
- Consider a range of alternative options
- Consider tradeoffs
- Use best available science to understand the potential consequences of their actions
- Contemplate the decision from a wide range of views and vantages
- Follow agreed-upon rules and norms that enhance the legitimacy of the process and its outcomes

(Courtesy of: Robert Lempert and Steven Popper)

Provided Quantitative Information is Not Always Well-Matched to Decision Challenge

		Can Users Benefit?	
		YES	**NO**
Is information relevant?	**YES**		Users disenfranchised or face barriers to use
	NO		

Modified from Sarewitz and Pielke (2007)

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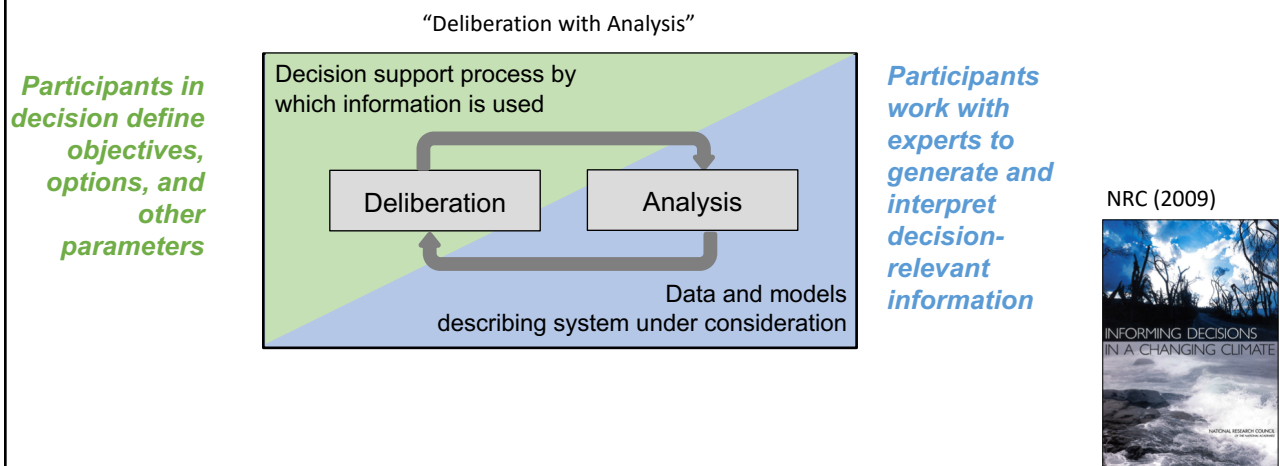|		Can Users Benefit?	
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	NO	Inappropriate information	Disenfranchised users, inappropriate information

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Provided Quantitative Information is Not Always Well-Matched to Decision Challenge

|		Can Users Benefit?	
		YES	**NO**
Is information relevant?	**YES**	Well-informed, empowered users	Users disenfranchised or face barriers to use
	NO	Inappropriate information	Disenfranchised users, inappropriate information

Modified from Sarewitz and Pielkē (2007)

DMDU Recognizes the Importance of Providing Appropriate Information to Decision Makers

Participants in decision define objectives, options, and other parameters

"Deliberation with Analysis"

Decision support process by which information is used

Deliberation → Analysis

Data and models describing system under consideration

Participants work with experts to generate and interpret decision-relevant information

NRC (2009)

INFORMING DECISIONS IN A CHANGING CLIMATE

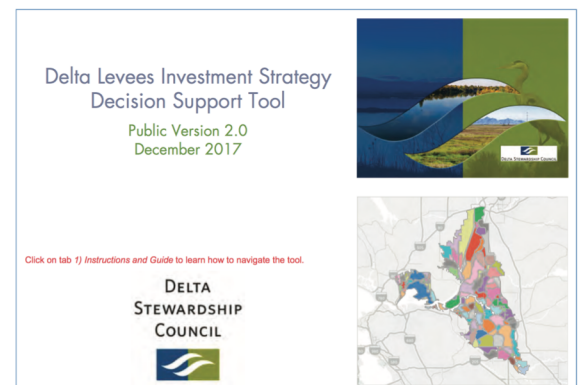## Rapidly-Deployable Decision Support Helps Deliberation with Analysis

1. Supports deeper understanding by data exploration
   - Scenarios and system interrelationships
2. Enables consideration of tradeoffs
   - Values and expectations
3. Supports actual decision processes
   - Relevant
   - Timely
   - Easily deployed

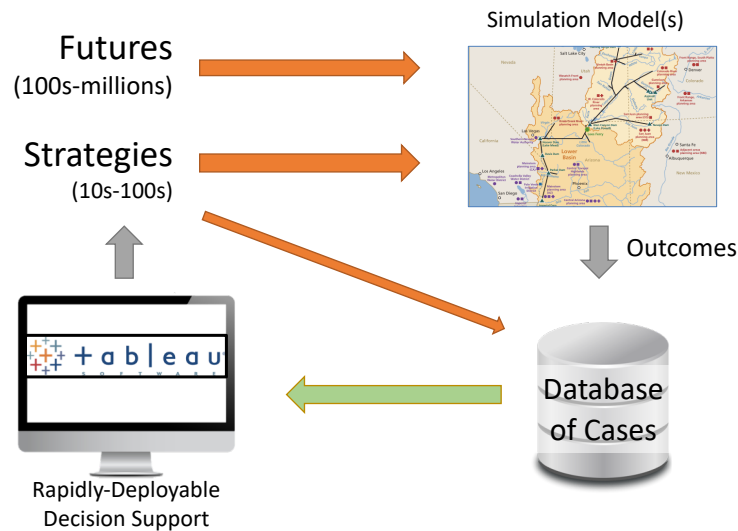Fits into decisionmaking under deep uncertainty processes

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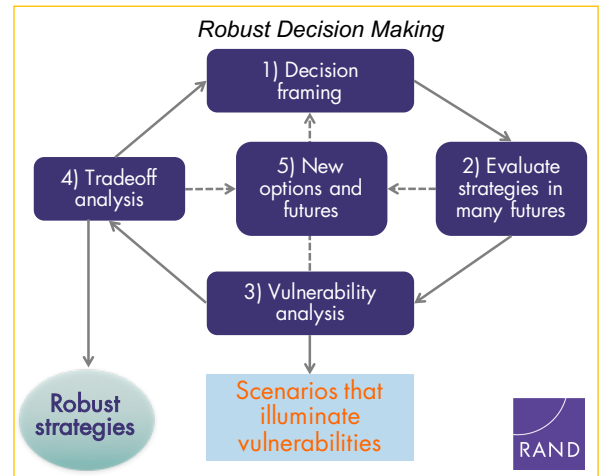
First Example: Decision Support Tool Helped Develop Priorities for California Bay-Delta Levee Investment Program

- Developed concurrently with analysis
- Displayed different levee failure flood risk estimates
- Enabled user exploration of risks across islands, metrics, and future assumptions
- Supported prioritization of islands based on risk

http://deltacouncil.ca.gov/delta-levees-investment-strategy

General Architecture of a Rapidly-Deployable Decision Support Tool

Futures
(100s-millions)

Strategies
(10s-100s)

Simulation Model(s)

Outcomes

Database of Cases

Rapidly-Deployable
Decision Support

11

Choosing a Decision Support Software System…

Good Attributes
- Data agnostic
- Flexible
- Deployability
- Easy to develop and use
- Affordable

Options
- Tableau Software
- Power BI
- R-Shiny
- Many others…

12

Why We Like Tableau

+ t a b l e a u
  S O F T W A R E

- Connects to arbitrary datasheets or databases to create flexible source of data
- Drag-n-drop visualization creation
- Deployable to the public or select groups via the web
- Not free, though….

13

Use case: Exploring uncertainty and defining vulnerabilities

DMDU: *Evaluates large ensembles of futures*

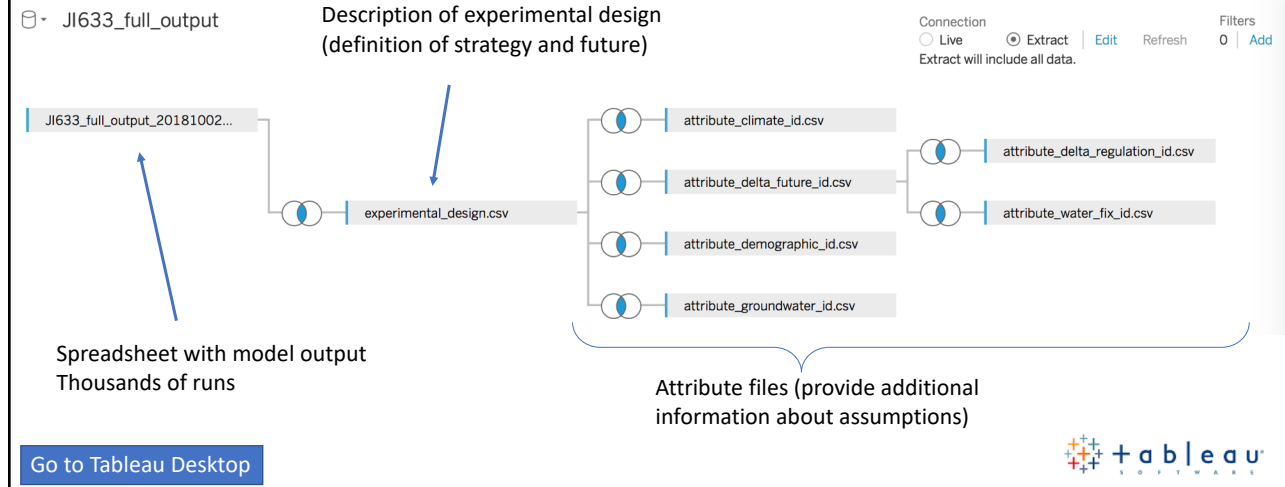Participatory, Interactive Analysis: *Explores the uncertainty and helps define vulnerabilities*
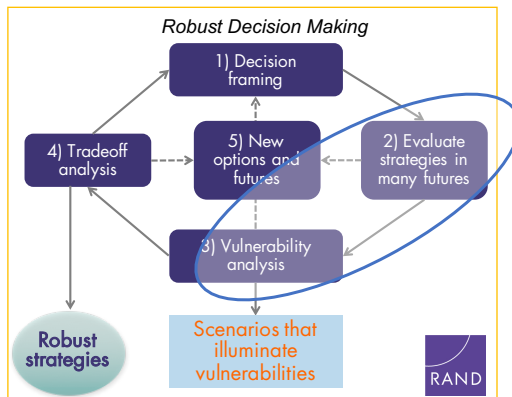
Metropolitan Water District using RDM and rapidly deployable decision support tool to stress test its Integrates Resources Plan and define adaptation strategy

Robust Decision Making

1) Decision framing

4) Tradeoff analysis

5) New options and futures

2) Evaluate strategies in many futures

3) Vulnerability analysis

Robust strategies

Scenarios that illuminate vulnerabilities

RAND

14

Creating a Visualization Database from Different Datasheets (.csv)

Spreadsheet with model output
Thousands of runs

Description of experimental design
(definition of strategy and future)

Attribute files (provide additional information about assumptions)

Go to Tableau Desktop

Use Case: Supporting stakeholder engagement and development of strategies

DMDU: *Seeks Robust Strategies*
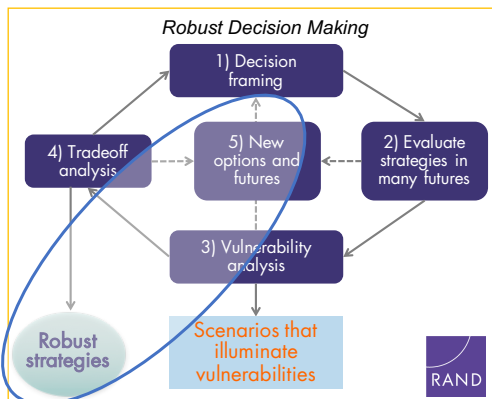
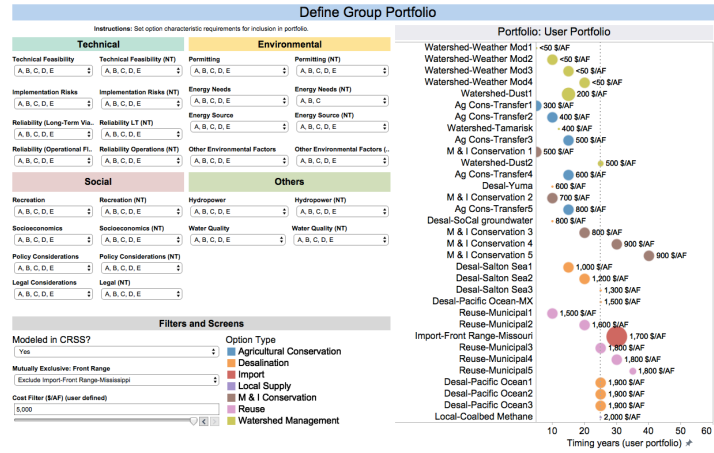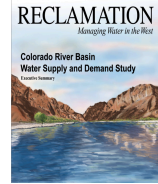Participatory, Interactive Analysis: *Assimilates stakeholder and expert ideas for strategies*

Colorado River Basin Study used rapidly-deployable decision support tool to explore model simulations and develop *stakeholder-informed portfolios of options*.
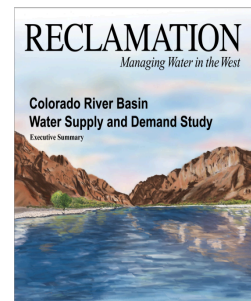
Colorado River Basin Study Portfolio Development Tool

- Assimilated simulation results from more than 50 different water management options
- Provided additional contextual information about options
- Enabled stakeholders to build different portfolios of options for later evaluation and comparison
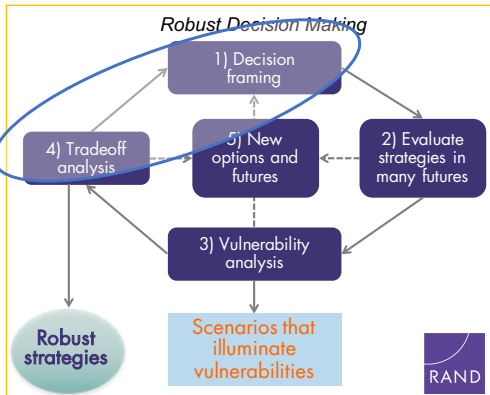

https://www.rand.org/jie/infrastructure-resilience-environment/projects/colorado-river-basin/interactive-brief.html

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# Use Case: Presenting tradeoffs to decision makers

DMDU: *Considers diverse perspectives*

Participatory, Interactive Analysis: *Evaluates tradeoffs across outcomes and preferences*

Robust Decision Making

1) Decision framing
4) Tradeoff analysis
5) New options and futures
2) Evaluate strategies in many futures
3) Vulnerability analysis
Robust strategies
Scenarios that illuminate vulnerabilities
RAND

Puerto Rico's $130 Recovery Plan was developed using planning support tool to synthesize information about damages and possible actions across

Go to Tableau Desktop
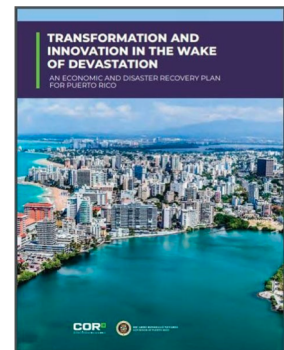
Final Thoughts on Decision Support Tools for Deliberation with Analysis

- Decision support tools need to:
  - Reflect *uncertainty about the future*
  - Support *deliberations over tradeoffs*
  - Contain *relevant and timely* information

- Different tools could be helpful at different stages of the process
  - support iterative analyses
  - inform real-time decisions
  - present final information

RAND Center for Decision Making Under Uncertainty

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