Adapting to multiple and uncertain changes in the Mekong Region using Robust Decision Support – a SUMERNET regional assessment

Albert Salamanca

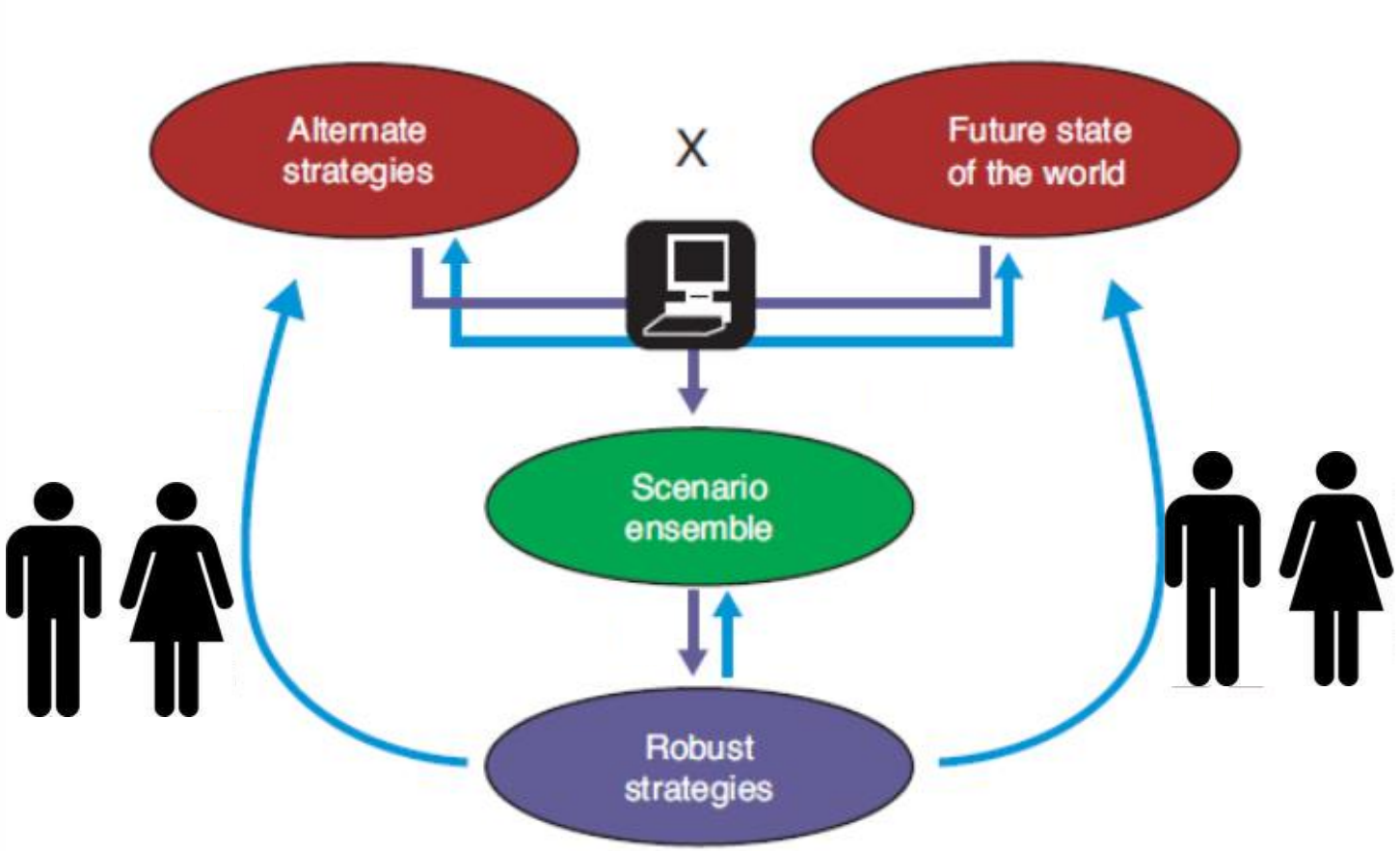
A Key Question

- How do we decide between potential water management options in a way that:
  - Meets the water management objectives of the broadest spectrum of stakeholders;
  - Reduces the negative impacts felt by any particular stakeholder; and
  - Takes into account future conditions (climate change, population growth, economic development)?

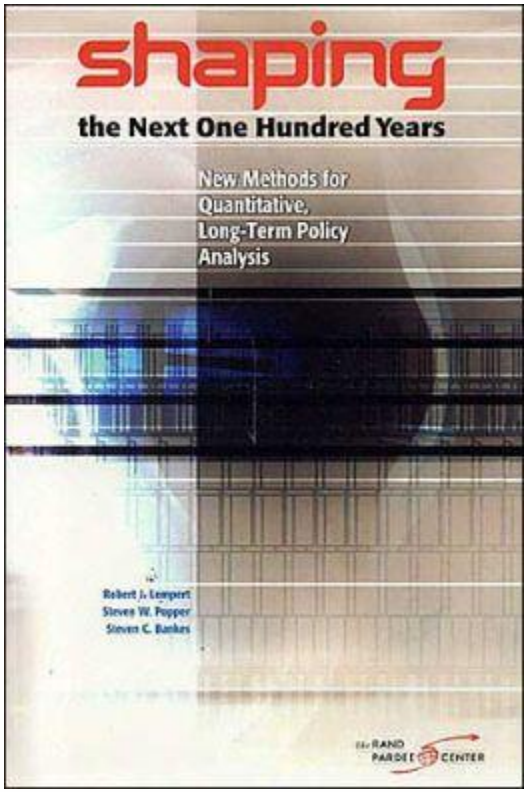
The “Predict then Act” Approach

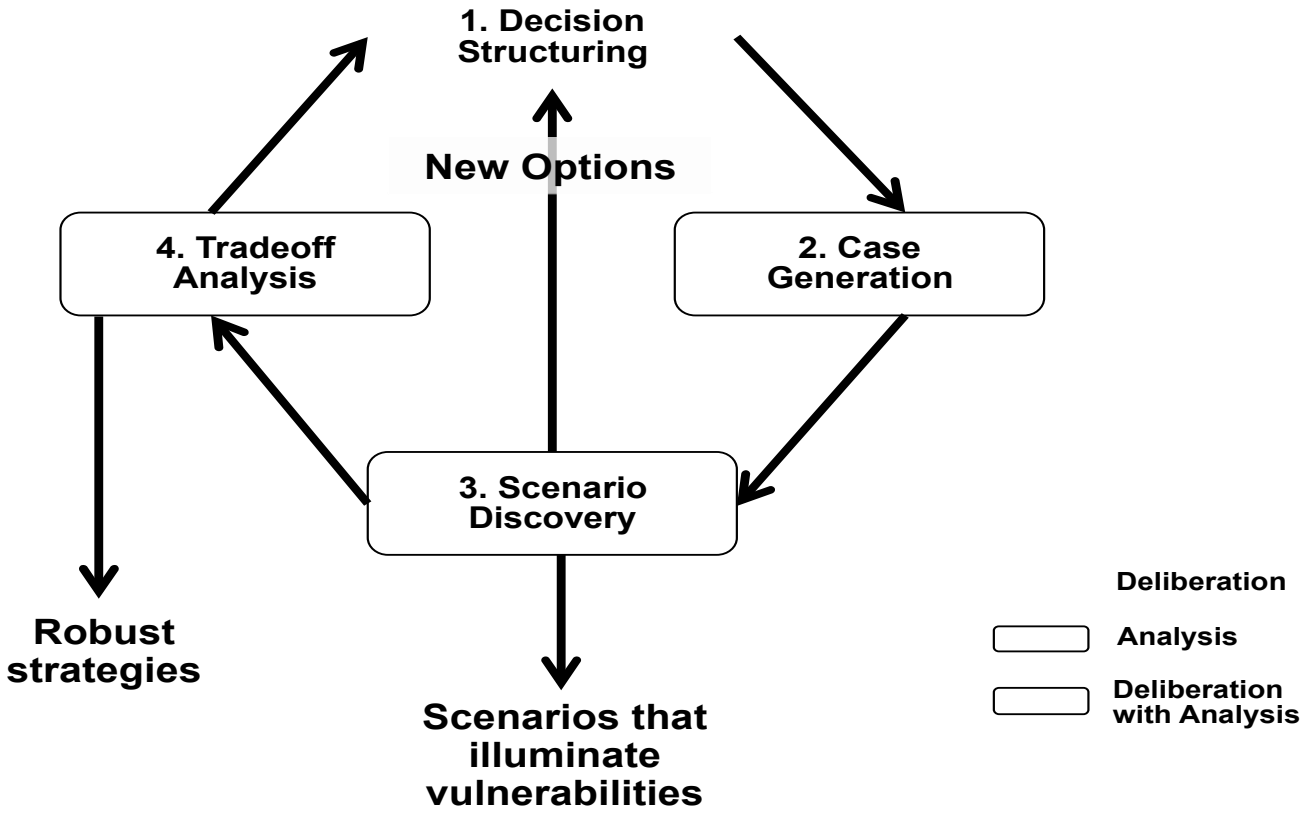
Collect Information → Conduct Analysis → Make Decision

The “Deliberation with Analysis” Approach



Decision Making Under Uncertainty: Robust Decision Support

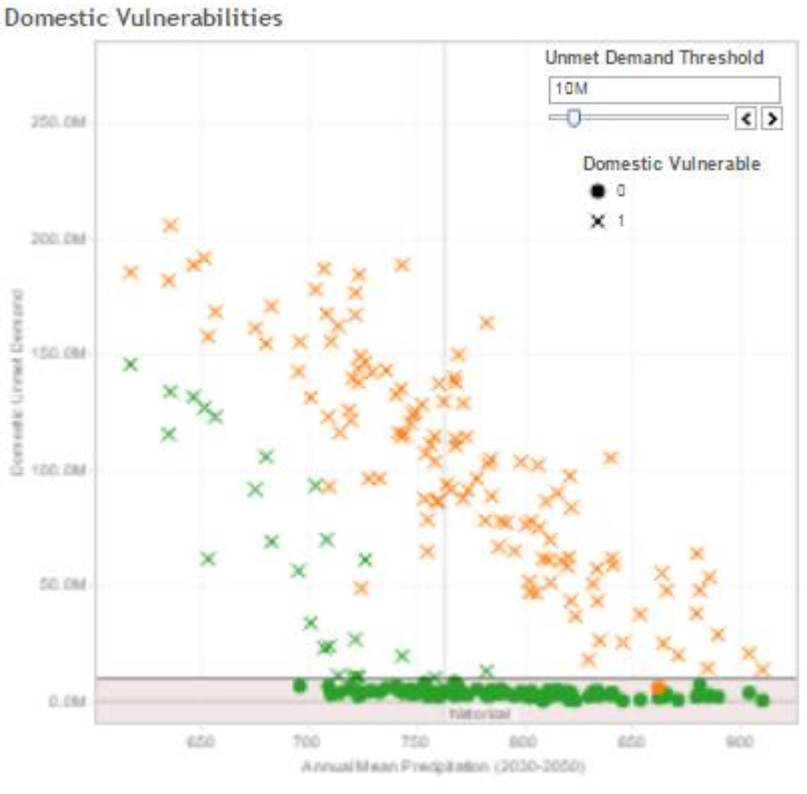




http://www.rand.org/pubs/monograph_reports/MR1626.html

Some RDM Characteristics

- Assumes that “Predict then Act” is not suited to current challenges.
- Takes advantage of the power of digital computing to explore a large ensemble of possible futures.
- Anticipates that the analysis will identify the most “robust” outcome.



Considers a Range of Management Actions

Water management strategies evaluated: Improved efficiency; Wastewater reuse; Conjunctive use; Environmental flows.

Management Baseline or Response Package	Resource Management Strategy						
	URBAN WATER-USE EFFICIENCY	AG WATER-USE EFFICIENCY	RECYCLED MUNICIPAL WATER	CONJUNCTIVE MANAGEMENT AND GROUNDWATER		ECOSYSTEM RESTORATION	SURFACE STORAGE
				Groundwater Banking	Groundwater Recovery Targets	Environmental Flow Targets	
Currently Planned Management	20% by 2020	Current	Current	Current	Limit: Historical low	Flow requirements	**This strategy could not be evaluated as part of the Central Valley Vulnerability Assessment (See Box 5-5).**
Diversification Level 1	20% by 2020; 30% by 2030	10%, by 2020	Current	Current	Limit: Historical low	Flow requirements	
Diversification Level 2	20% by 2020; 30% by 2030	10%, by 2020	50% recycled water use, by 2030	Up to 20 taf/month/ planning area, beginning in 2020	Limit: Historical low	Flow requirements	
Diversification Level 3	20% by 2020; 30%, by 2030	10%, by 2020	50% recycled water use, by 2030	Up to 20 taf/month/ planning area in SOD, beginning in 2020	Limit: Average of historical low and initial levels in WMM, beginning in 2015	Flow requirements plus additional targets, beginning in 2015	
Diversification Level 4	30% by 2030 30% by 2030; 35% by 2040	10%, by 2020; 15%, by 2030	50% recycled water use, by 2030	Up to 40 taf/month/ planning area in SOD, beginning in 2020	Limit: Average of historical low and initial levels in WMM, beginning in 2015	Flow requirements plus additional targets, beginning in 2015	
Diversification Level 5	30% by 2030; 30% by 2030; 40% by 2040	10% by 2020; 20% by 2030	50% recycled water use, by 2030	Up to 40 taf/month/ planning area in SOD, beginning in 2020	Limit: Average of historical low and initial levels in WMM, beginning in 2015	Flow requirements plus additional targets, beginning in 2015	

Notes:

taf = thousand acre-feet, SOD = South of Delta, WMM = water management model

Shading denotes relative levels of effort for each strategy.

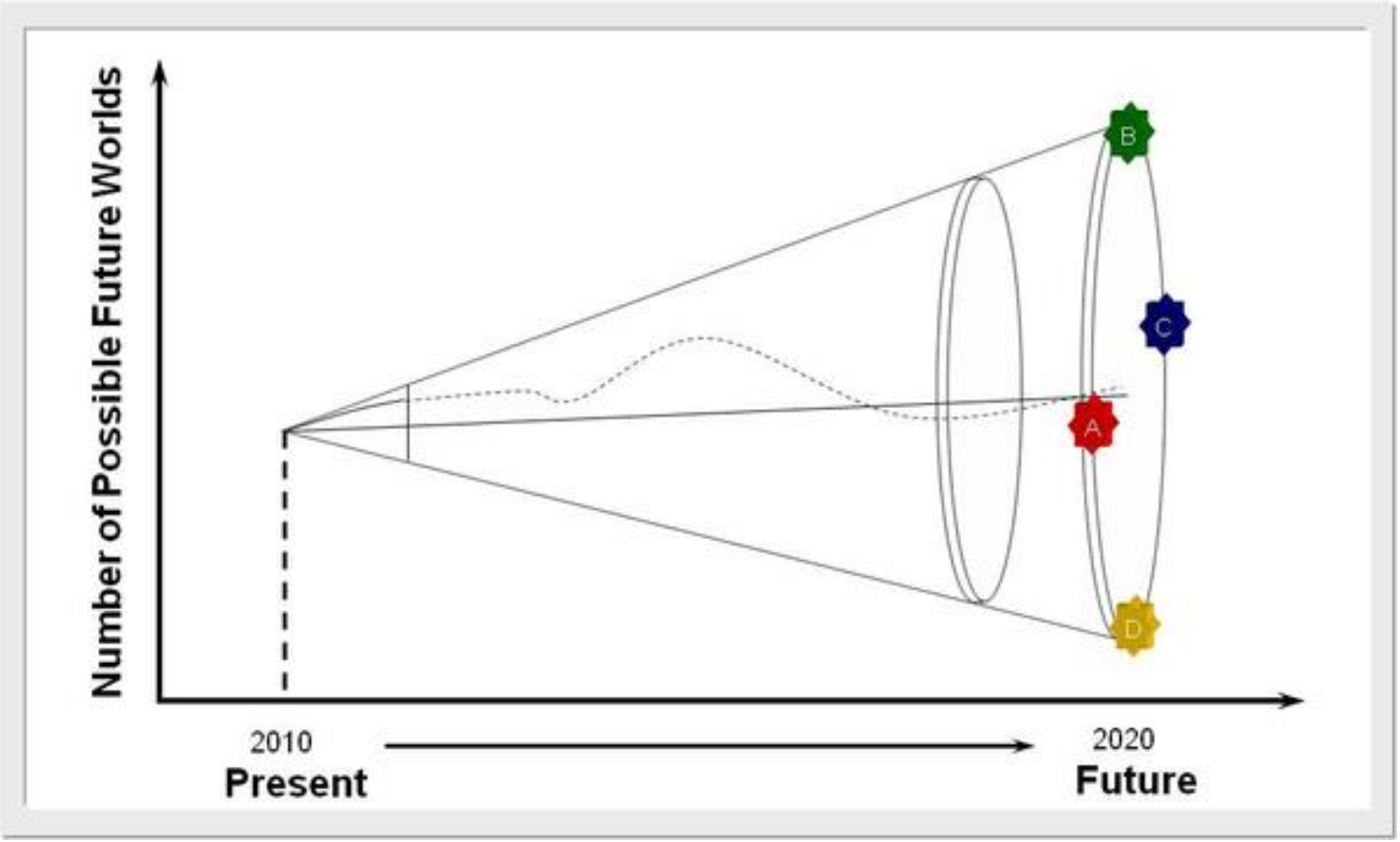
RDM becomes RDS

- 2012: Infrastructure plan for La Paz/El Alto, Bolivia
- 2013-2015: Watershed planning in Colombia
- 2014-2105: Identifying water management adaptations to climate change in Peru and Colombia.
- 2015: IRWM in California

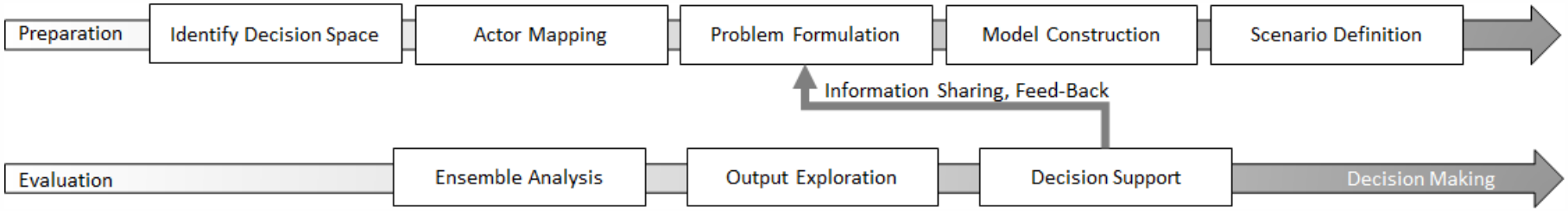
The SEI Practice of Robust Decision Support

- Based on XLRM problem formulation build and calibrate a **model** that represents the **current system**
- Run the model of the current system under and ensemble of **multiple future scenarios**, extracting values for user defined **performance metrics** from each run
- Visualize the **performance space** defined by the ensemble of model runs and define minimum acceptable and maximum aspirational **thresholds** for each metric
- The performance of the system with respect to defined thresholds defines the **vulnerability** of the current system
- Using this **baseline**, it is possible to evaluate how **different available management options** reduce the system vulnerability across multiple dimensions of performance.

Wide Range of Scenarios Describing the Future



A Process to Implement RDM: Robust Decision Support



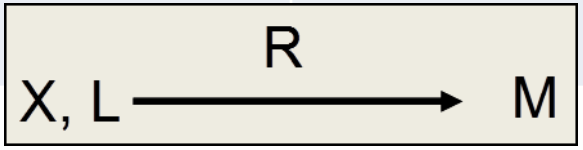
- A set of formal steps to guide actors through the process of evaluating the performance of potential decision.
- The goal is to co-create knowledge and insight that leads to agreement around appropriate actions and not disagreement about data and information

How Does RDS Compare to RDM

- How is it similar?
  - Based on XLRM problem formulation
  - Deploys an ensemble of model runs
- How does it differ?
  - Based on a formal participatory process
  - Typically based on an experimental design with a smaller number of scenarios (generally fewer climate scenarios)
  - Typically based on an experimental design with a larger number of performance metrics
  - Exploration of model output visualizations leads participants to a determination of “robust”, not an algorithmic analysis of the output

The “XLRM” Problem Definition Framework

Factors of Uncertainty (X)	**Management Options (L)**
Uncertain factors the our outside to the control of the managers and users of water resources, but which have the potential to impact outcomes – provide the basis for the creation of scenarios	Management options, or strategies, open to those who manage water resources: - The current system - Alternatives (e.g. infrastructure, behavioral change, regulatory reform)
Models or Relationships (R)	**Metrics of Performance (M)**
Models to estimate performance metrics (M) for an individual management option (L), or strategy, for a specific future set of uncertainties (X), or scenario	Evaluation criteria used to evaluate the performance of a the proposed management options



Additional Policies Are Robust Over a Wider Range of Future Conditions

Lempert, R., Kalra, N., Peryraud, S., and Sinh, T., 2013, *Ensuring Robust Flood Risk- Management in Ho chi Minh City. (Policy Research Working Paper from the World Bank # 6465)*, Washington DC: World Bank.