

DECISION ANALYTICAL TOOLS IN SUPPORT OF RESTORATION



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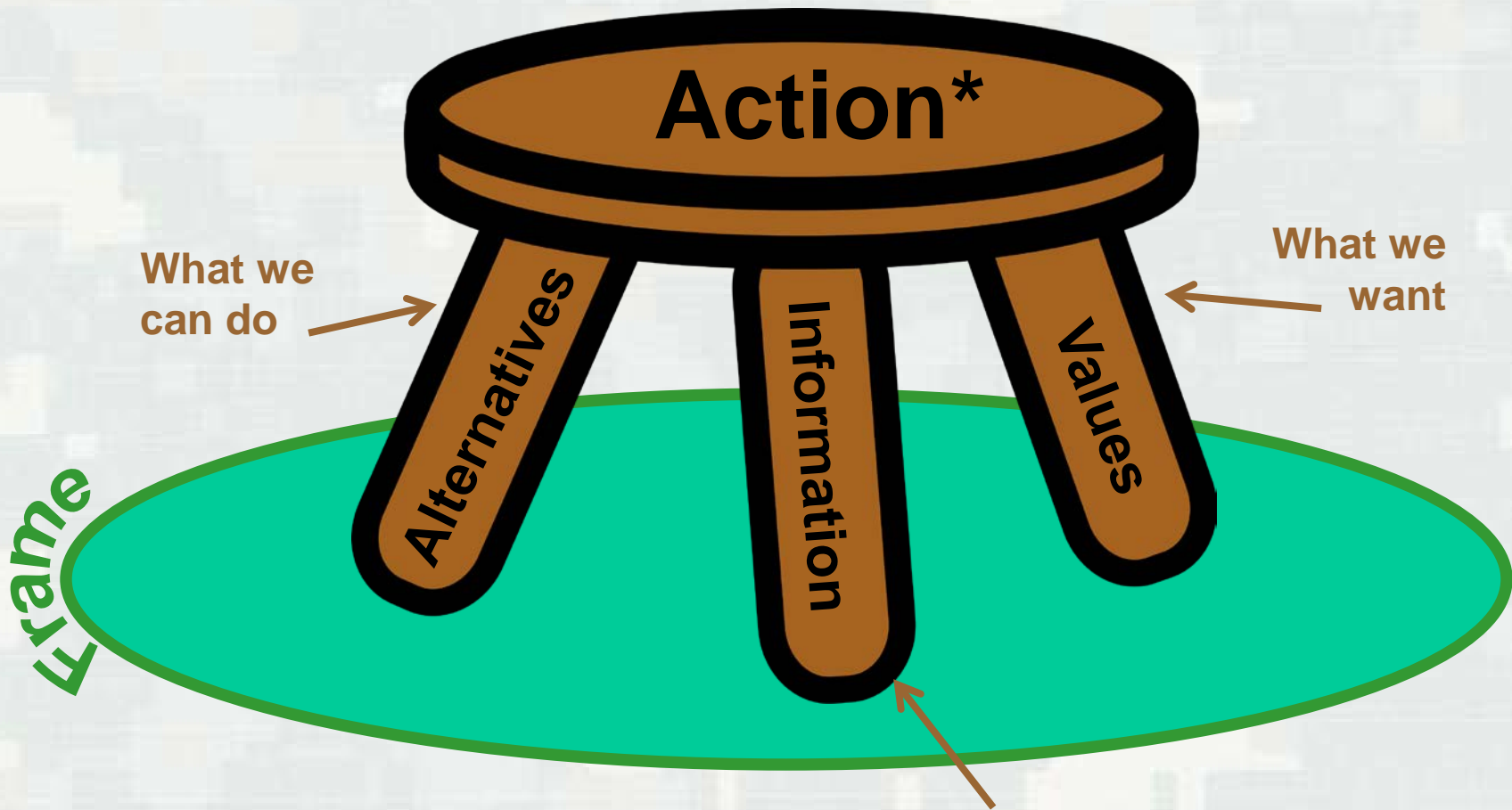


Context

- Formalized risk decision analytical processes provide mechanisms for communication, transparency and learning through implementation.
- Requires commitment to choice of a course of action, and additional effort – *over a range of complexity* - in inclusion of stakeholders' views and possibly other formalized models.



Decision Analysis



* Informs course of action

BUILDING STRONG®

What we know



Innovative solutions for a safer, better world

Range of Complexity - Progression

- Narrative
- Structured MCDA
- Stakeholder engagement
- More complex applications
 - Robust decision making – scenario analysis
 - Learning from implementation - adaptive management
 - Additional measurement - value of information

Narrative

- Often embedded in project documents
- What is/are your objectives?
 - ▶ Habitat vs. Population
- What would success look like?
 - ▶ Specify measurements (metrics) that reflect level of success
 - ▶ “What gets measured, gets done.”
- Metrics drive monitoring plan

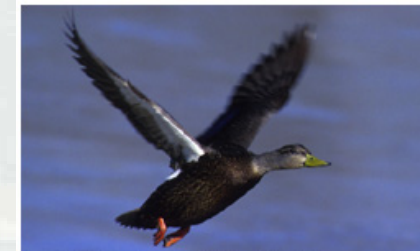


Photo by Maslowski Photo / USFWS



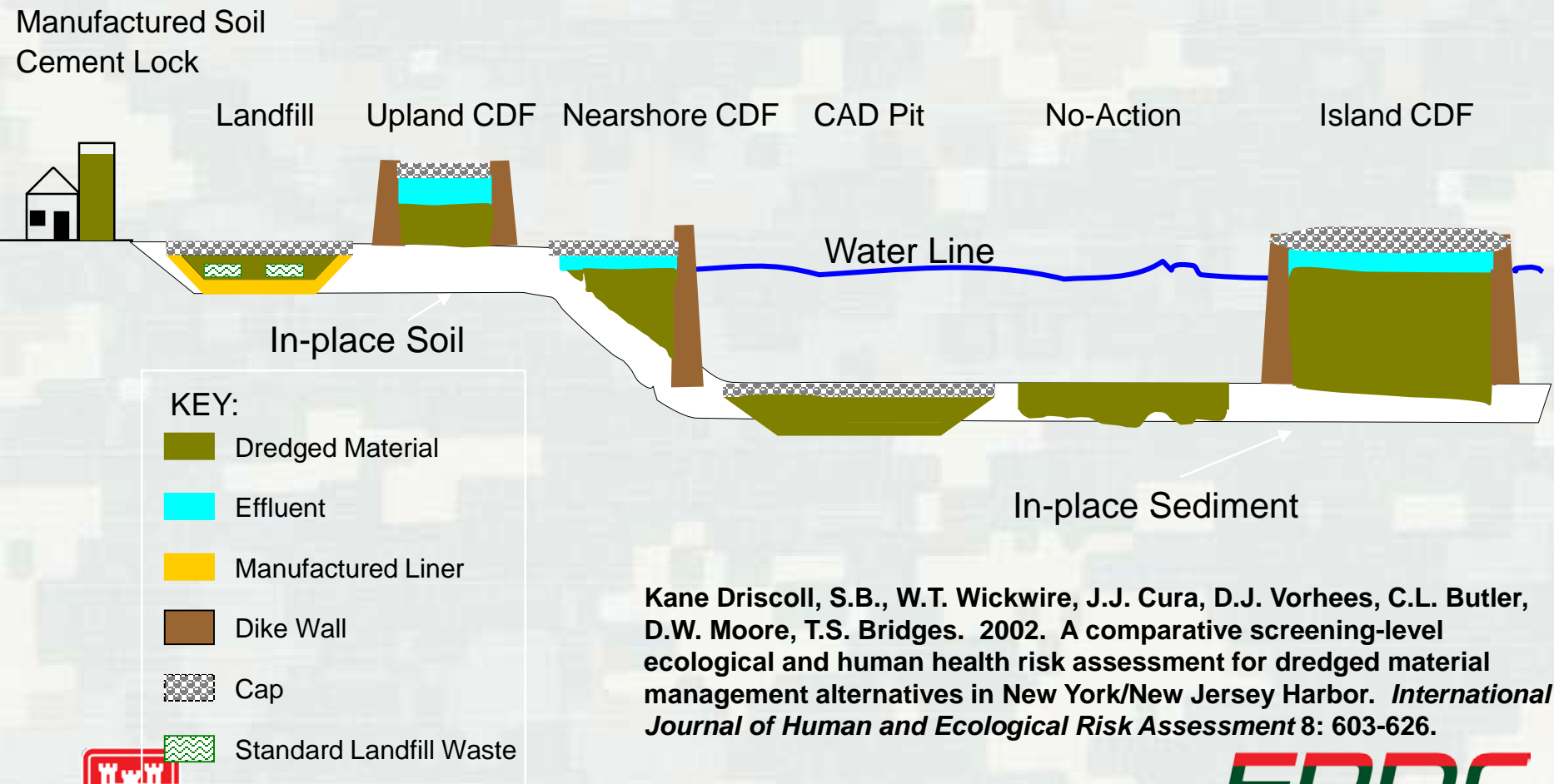
Narrative

- Costs
 - ▶ Can be inconsistent
 - ▶ May not reflect views of all partners, stakeholders
 - ▶ There may be many objectives, and trade-off are not usually specified
- Benefits
 - ▶ Ability to compare different designs to stated objectives
 - ▶ Potential to identify partners with similar/different perspectives
 - ▶ Clarity in project implementation, and determining degree of success obtained



Structured MCDA

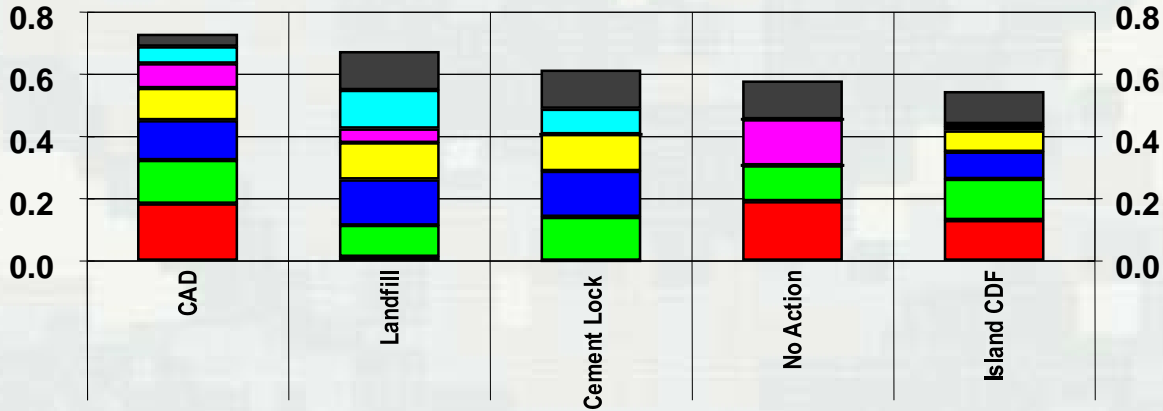
Example from NY/NJ Harbor



Kane Driscoll, S.B., W.T. Wickwire, J.J. Cura, D.J. Vorhees, C.L. Butler, D.W. Moore, T.S. Bridges. 2002. A comparative screening-level ecological and human health risk assessment for dredged material management alternatives in New York/New Jersey Harbor. *International Journal of Human and Ecological Risk Assessment* 8: 603-626.

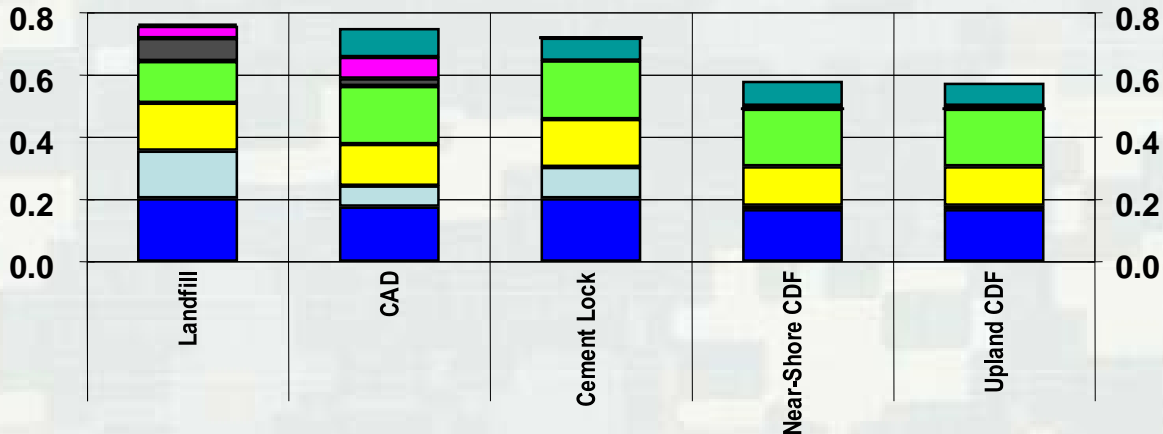


Structured MCDA



USACE weighting

- Cost
- Maximum Cancer Probability (Non-Barge Worker)
- Ecological Hazard Quotient
- Est. COC Conc in Fish / Risk-based Conc
- Complete Human Health Exposure Pathways
- Complete Ecological Exposure Pathways
- Ratio of Impacted Area to Facility Capacity



EPA weighting

- Cost
- Maximum Cancer Probability (Non-Barge Worker)
- Ecological Hazard Quotient
- Est. COC Conc in Fish / Risk-based Conc
- Complete Human Health Exposure Pathways
- Complete Ecological Exposure Pathways
- Ratio of Impacted Area to Facility Capacity



Note each alternative evaluated technically and transparently in contribution to overall score.



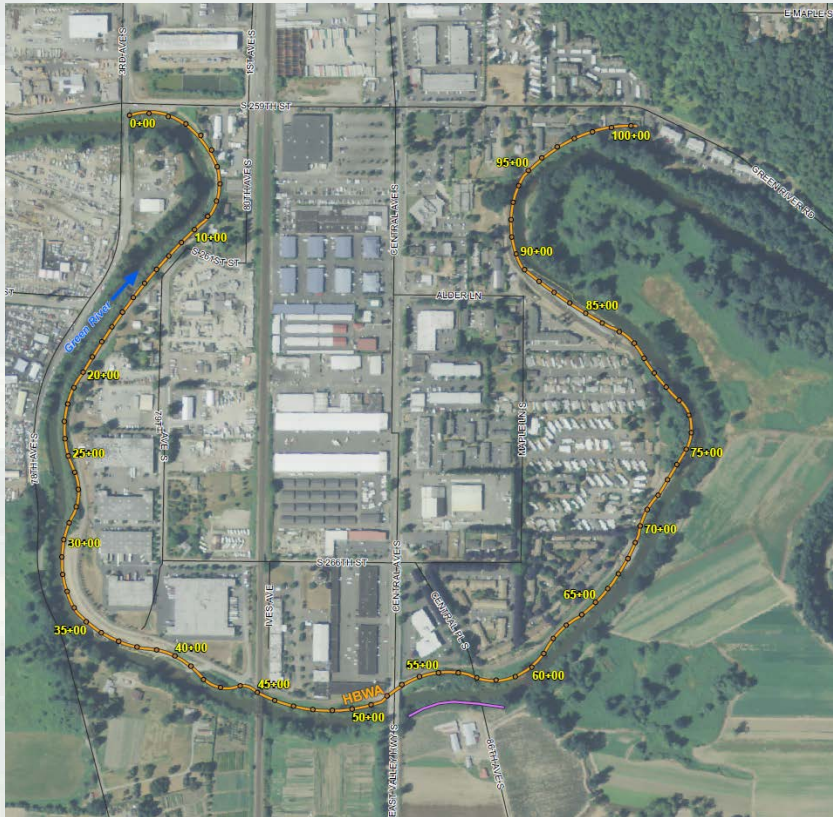
Structured MCDA

- Costs
 - ▶ Time consuming
 - ▶ May require external support
 - ▶ Should be started early in the process
- Benefits
 - ▶ Ability to separate preference for an alternative from the alternative itself (NIMBY)
 - ▶ Often generates new options based on the understanding of performance proposed measures
 - ▶ Can improve stability of decision, and support moving forward



Stakeholder Engagement

Horseshoe Bend, Kent WA



Example Stakeholder Interview Question

--begin question--

- **Corps ERDC:** Please rank the following criteria in order of importance (listed alphabetically): Community Resilience, Cost, Fish / Salmon Health, Flood Risk Management, Implementability, Levee Safety / Reliability, Tribal and Public Use, Water Quality.
- **HBRST Member:** Levee Safety / Reliability would be first, then Fish / Salmon Health, Cost, Implementability, Flood Risk Management and Community Resilience are about the same, then Tribal and Public Use, and Water Quality would be last.
- **Corps ERDC:** You indicated that Levee Safety / Reliability is most important. If Levee Safety / Reliability was given 100 points, how many points would you give to the other criteria relative to 100? The total number of points across criteria is not important.
- **HBRST Member:** 85 points to Fish / Salmon Health, 60 points to Cost, and 55 points to Implementability. Flood Risk Management and Community Resilience would both get 40 points, 22 points for Tribal and Public Use, and 5 points to Water Quality.

--end question--

Criteria	Ranking (1 - 8)	Score (0 - 100)
Levee Safety / Reliability	1	100
Fish / Salmon Health	2	85
Cost	3	60
Implementability	4	55
Flood Risk Management	5	40
Community Resilience	5	40
Tribal and Public Use	7	22
Water Quality	8	5



Stakeholder Engagement - Response

- Stakeholder feedback
 - ▶ Two 'winning' designs
 - Feasibility
 - ▶ Interview read-ahead encouraged agency introspection
 - ▶ Process allowed for open communication in a safe environment
 - Teaching & learning moments
 - Solutions focused
- Lessons learned
 - ▶ MCDA results should be a midpoint for a larger discussion, not endpoint
 - ▶ Spend more effort on developing sub-criteria terms & definitions with stronger cross-agency consensus



Stakeholder Engagement

- Costs
 - ▶ Ideal to have individual interviews
 - ▶ Requires multiple meetings for feedback
 - ▶ Proper protocols and approaches increase value
- Benefits
 - ▶ Shows consideration of multiple perspectives
 - ▶ Identifies areas of disagreement in objectives and values instead of proposed action
 - ▶ Can improve cooperation and support development of novel approaches



More Complex Applications

“I have yet to see any problem, however complicated, which, when looked at in the right way, did not become still more complicated.”

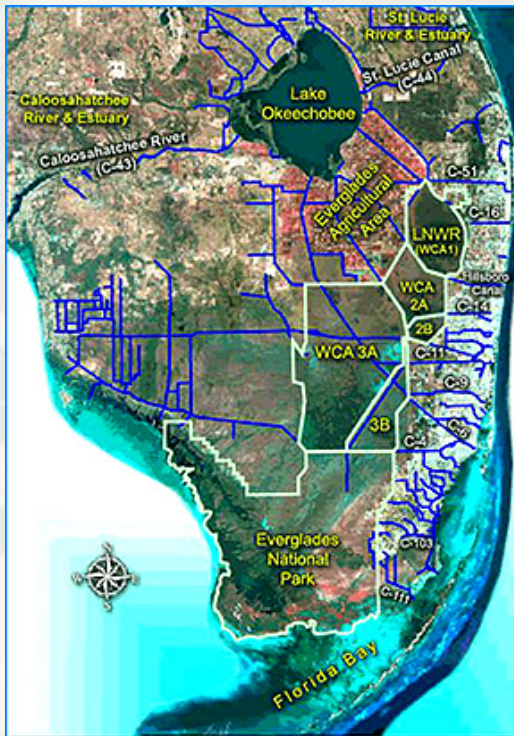
- Poul Anderson

- Why would you want to add complexity?
- If that complexity impacts your decisions, and it is not captured, decisions won't be appropriate.



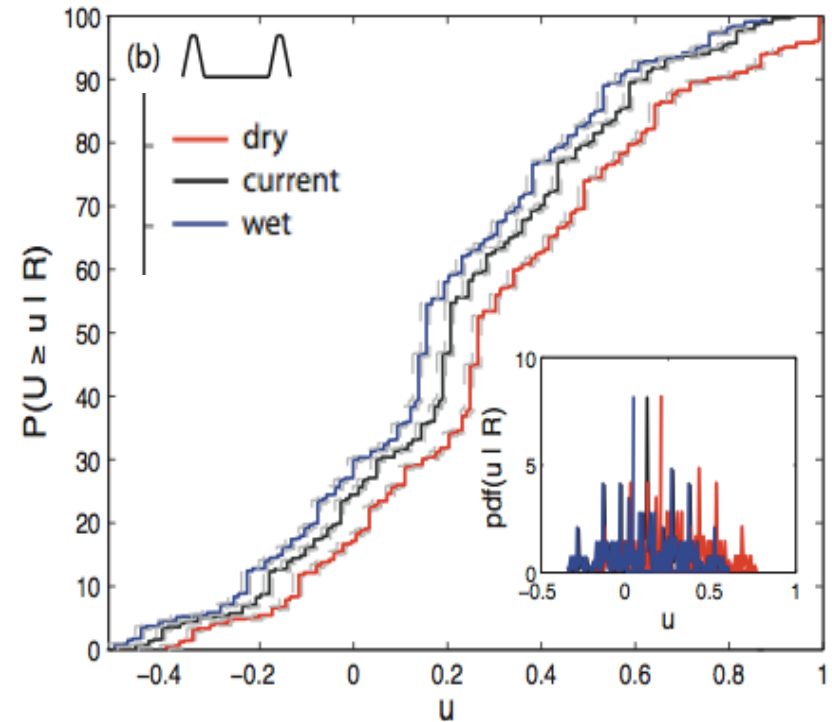
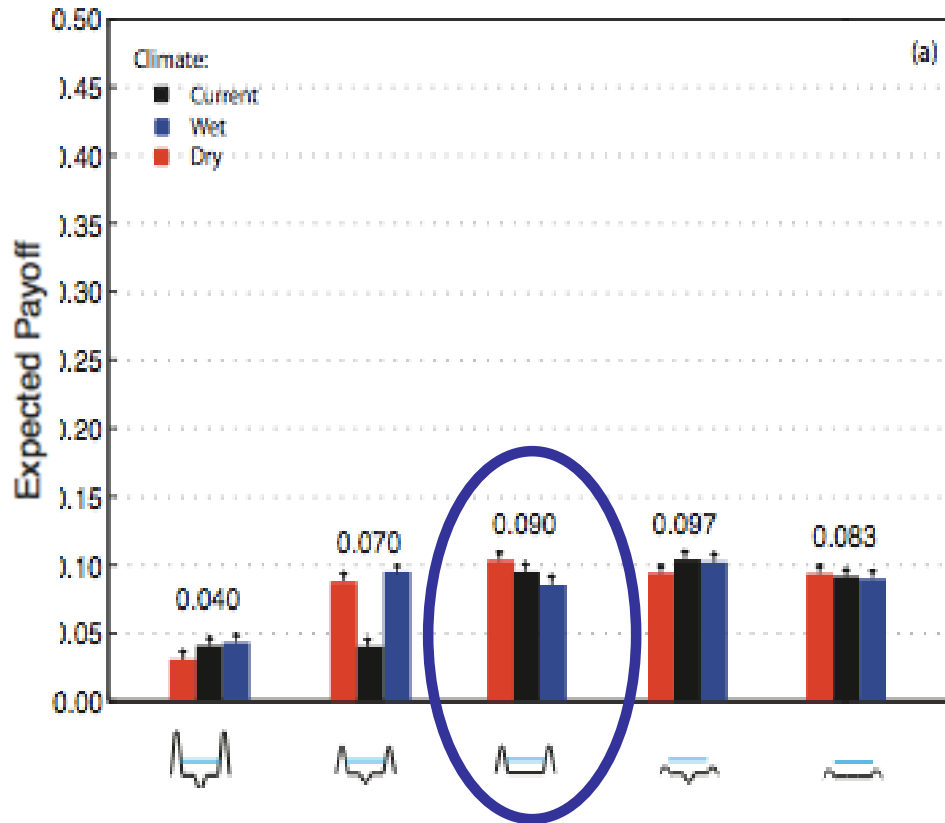
Calculate “Payoff” under Scenario

The tool goes through possible inflow or “rain” drivers to the system – for each management alternative – calculating payoff from fish and bird population projections.

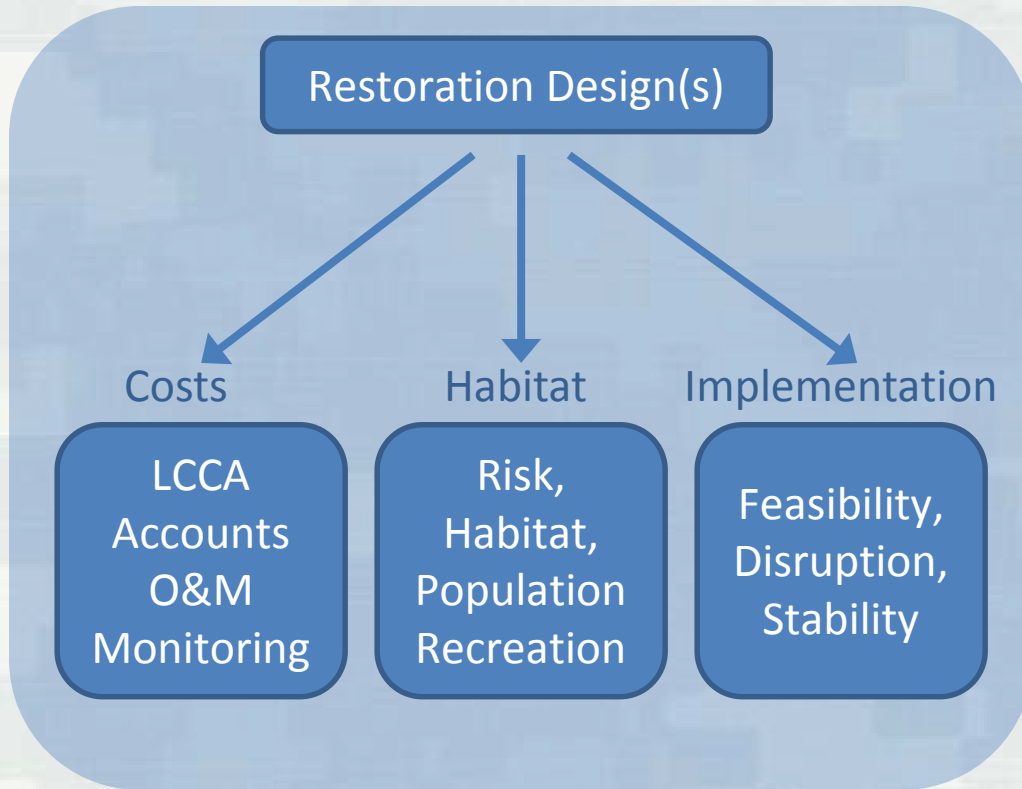


Estimates of Payoff and Robustness

Varying: Precipitation



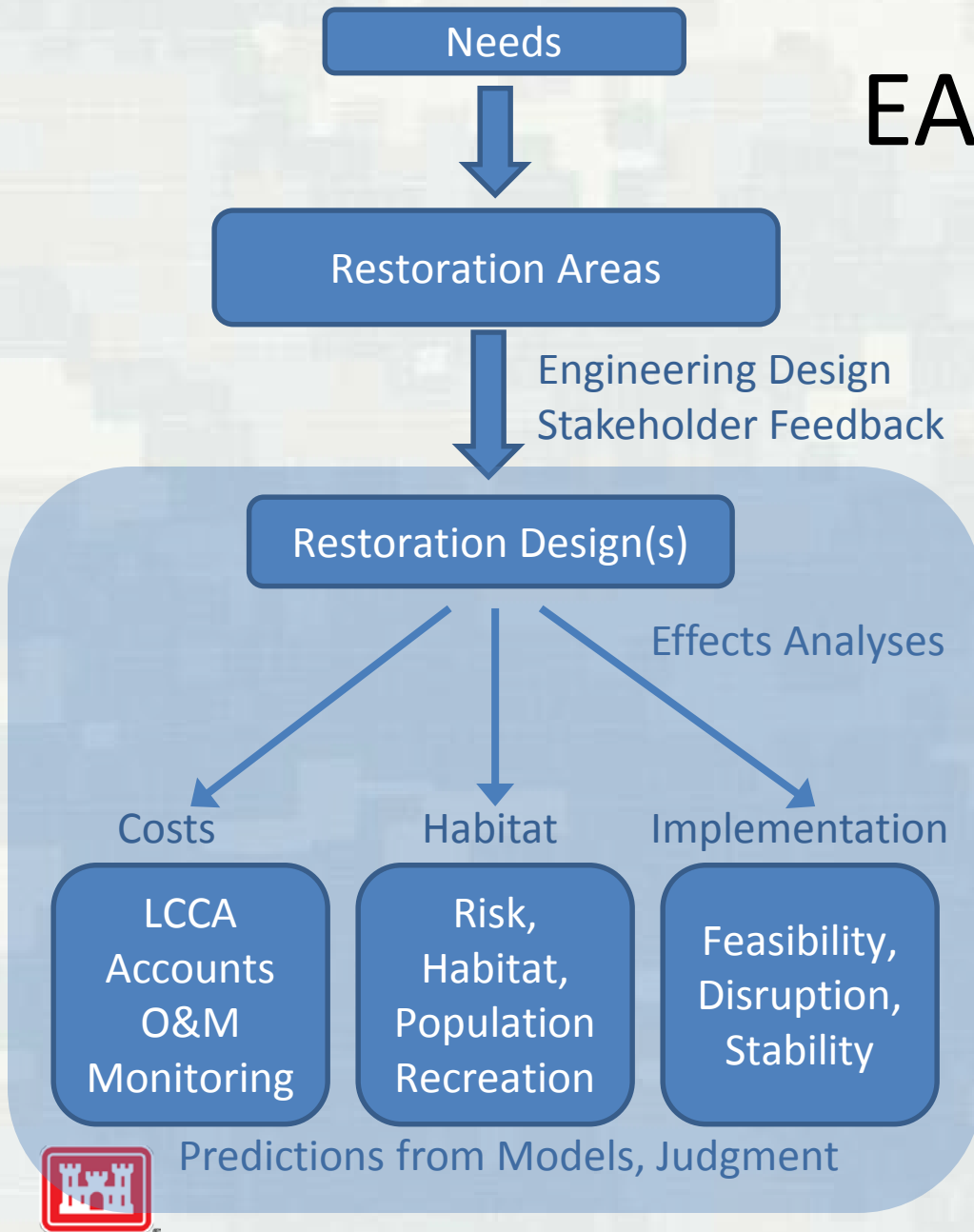
Adaptive Management



- Effects analysis forms the basis of a DM – Enhanced Adaptive Management (EAM)
- Integrates other models to anticipate effects
- Contains unknowns or uncertainties



EAM – Likely use



- Better prediction of outcomes based on refined models.
- Potential for alternative design and smoother implementation



Predictions from Models, Judgment

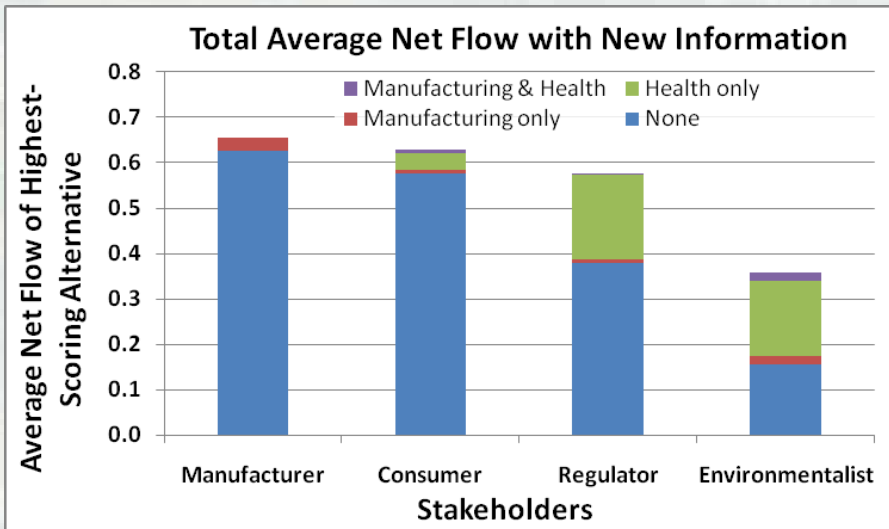


Value of Information

Nano-fabrication Case Study

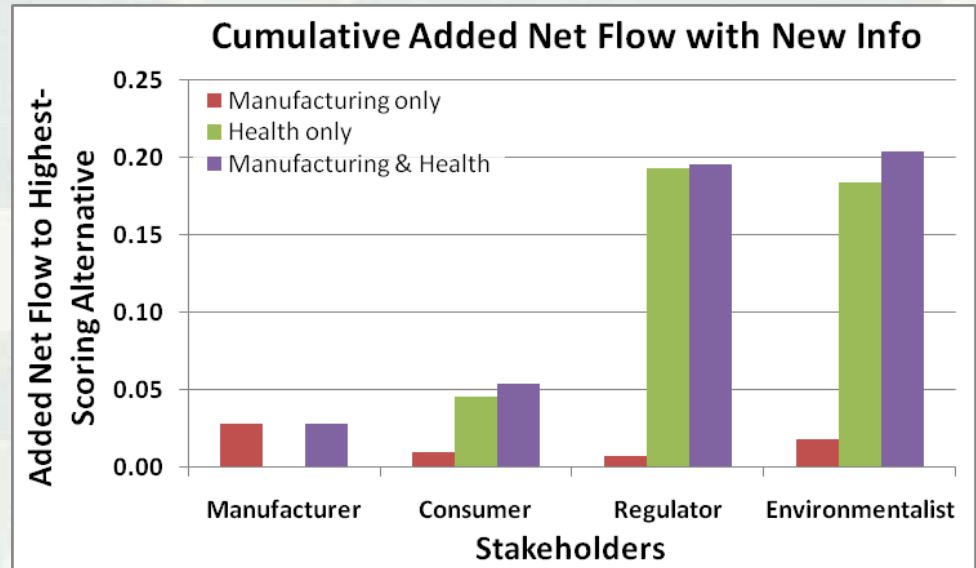
Alternative/ Criterion	Energy consumption (GWh/kg)	Material efficiency (% in mass)	LCIA Score (EcoPoints)	Cost (\$/g)	Health risks
GOAL	Minimize	Maximize	Minimize	Minimize	Minimize
HiPco					
CVD					
Arc					
Laser					

Nano-fabrication Vol Discussion



- Stability of “preference” determined by how important the uncertain elements are to your decision

- Can be used to determine which uncertainties are most important to resolve to have a clear “preference”



More Complex Applications

- Costs
 - ▶ Capturing complexity requires resources
 - ▶ May limit the number of participants “on board”
 - ▶ May introduce error
- Benefits
 - ▶ Provides a dynamic view of performance of a course of action
 - ▶ Can improve future management and project development
 - ▶ Provides best answer to “what if” and “what do we need to know” questions



Lessons learned about using Decision Analysis

- DA is a toolbox for increasing communication, clarity and archiving uncertainty. The more complex the application of DA, the more resources are required for implementation.
- As a trade-off the DA application can increase efficacy, engagement, robustness of actions, an understanding of complex systems and when additional information is critical to a decision.
- It requires a commitment to inclusion of different points of view, often through frequent and open communication. It is important to be clear about how the decision(s) will ultimately be made and the influence stakeholders can have on the decision.



Questions?



- *Cases are a selection of RaDST work.*
- *If you have specific interests or would like to discuss something further, please contact me.*

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