

Decision Analysis Sketch for PA

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Decision Risk



Potentially Unacceptable Health Risk



Basic Principles

- Decisions are made by evaluating decision risk
- Human health and environmental risk are components for evaluating decision risk for some types of problems (environmental, food)
- Decisions are made about populations rather than individuals
- Decision risk decreases with time (social discounting) – need “insurance” to address possible future concerns
- Modeling is performed in the context of decision risk

Lessons Learned

- There are some difficult environmental risk-based problems (see Discussion Paper for examples)
 - Thoughtful solutions are needed for good decisions
 - This requires effort
 - Conservatism often leads to poor decisions
 - Deterministic models do not allow uncertainties to be evaluated properly
 - Decision objectives should drive modeling needs
 - Solutions should be site-specific
 - Stakeholders should be involved throughout
 - Stakeholder values should be included

Path forwards?

- **Decision Analysis** provides a different approach to solving difficult environmental risk-based decision problems
 - A “Paradigm Shift”
 - A “Revolution” – really an “Evolution”?
- Some environmental programs are moving forwards in this regard (e.g., EPA sustainability, watershed management and land use programs)
- Food safety is moving in this direction (FDA)

Note both NRC and DOE have previously performed cost-benefit analysis for Performance Assessments (using population risk)

So, What is Decision Analysis?

- “Formalized common sense”
- A set of tools for structuring and analyzing complex decision problems
- An approach for making logical, reproducible, and defensible decisions in the face of:
 - Technical complexity
 - Uncertainty
 - Costs and value judgments
 - Multiple, competing objectives

Decision Analysis Approach

- Stakeholder involvement
 - Negotiate inputs, not the values of endpoints
 - Let formal DA process take care of the rest
- Defensibility, traceability, transparency, openness, vetting, agreement, etc.
- Iteration – prune, refine, add new (with new evidence/data)

Decision Analysis Cycle

- Identify objectives and decision options
- Build a model with available information
 - Probabilistic model (uncertainty) – e.g., PA model
 - Costs and value judgments
- Evaluate model – uncertainty analysis
- Can decision be made or should more information be collected (uncertainty analysis)?
- Perform sensitivity analysis and value of information analysis
- **Iterate**

Values, Compliance Period & Discounting

- Discounting
 - Temporal - Spatial
 - Social - Technological
- Value of Future Generations
- Compliance Period implies discount rate = 0 for the duration, and then a value of 0 thereafter
 - This is a discount function, rather than a simple rate
 - Current generation bear the full cost (pay now to protect future generations)
 - Can have unintended impacts on near-term generations

Decision Analysis Overview

- In the long run, it is best to choose the alternative (decision option) that provides the best expected outcome, given what you know or believe about future events.
- This is the basis of *cost-benefit analysis*.
- Evaluate **sustainability**: economics, environmental and social pillars
- Aim to ***Maximize expected societal welfare***




















Also – Risk management, Economic analysis....



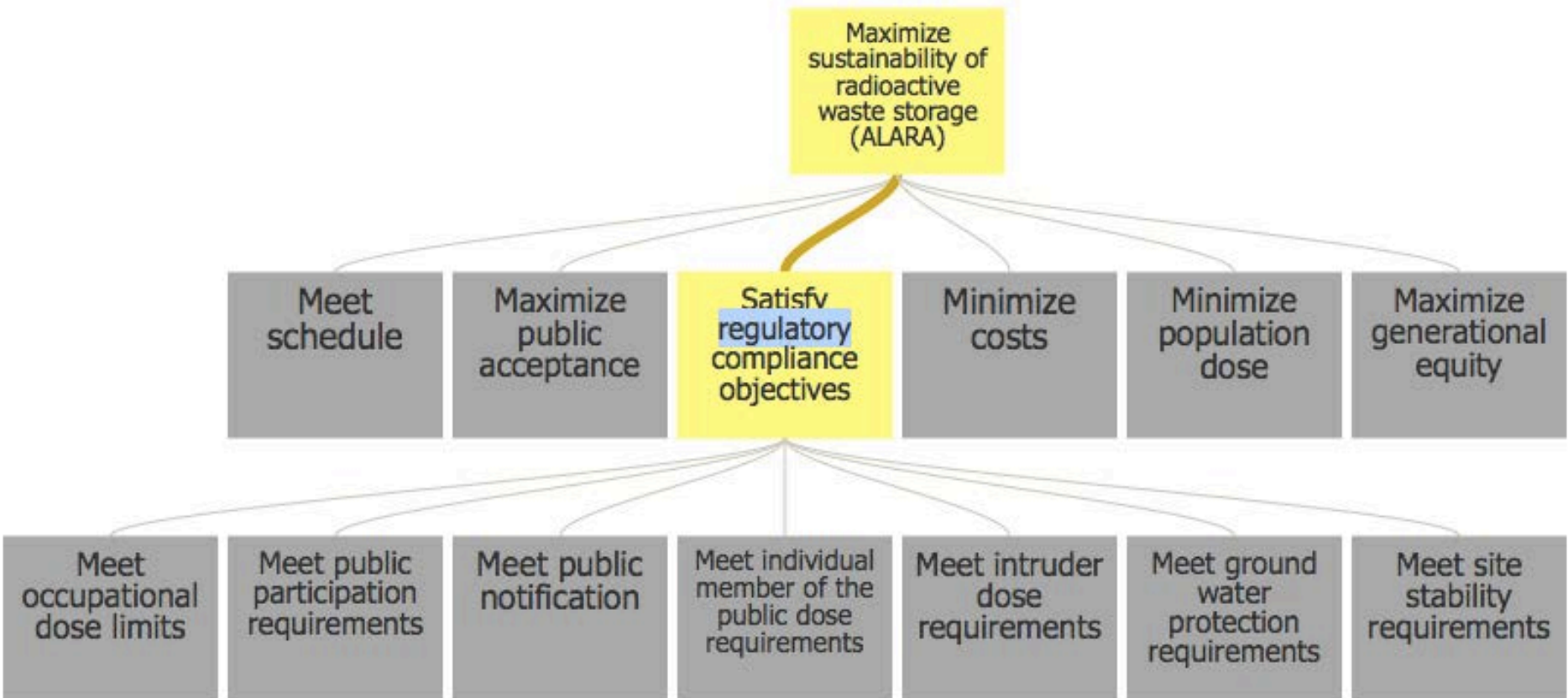


Objectives Hierarchy



- ▲  Maximize sustainability of radioactive waste storage (ALARA)
 -  Meet schedule
 -  Maximize public acceptance
 - ▲  Minimize costs
 -  Minimize engineered design costs
 -  Minimize maintenance cost
 -  Minimize transportation costs
 - ▲  Satisfy regulatory compliance objectives
 -  Meet individual member of the public dose requirements
 -  Meet public notification
 -  Meet ground water protection requirements
 -  Meet occupational dose limits
 -  Meet public participation requirements
 -  Meet intruder dose requirements
 -  Meet site stability requirements
 -  Minimize population dose
 - ▲  Maximize generational equity
 -  Maximize intra-generational equity
 -  Maximize inter-generational equity

Objectives Hierarchy



Structured Decision Analysis

Structured Decision Making: A Practical Guide to Environmental Management Choices

Robin Gregory, Lee Failing, Michael Harstone,
Graham Long, Tim McDaniels, Dan Ohlson

Wiley, March 2012