



# Government Decision Analysis: An Environmental Example

## **Dr. Richard F. Deckro**

Professor of Operations Research  
Department of Operational Sciences  
Air Force Institute of Technology  
AFIT/ENS, Bldg. 640  
2950th P Street  
WPAFB, OH 45433-7765  
richard.deckro@afit.af.mil

## **Dr. Gregory S. Parnell**

Class of 1950 Chair of Advanced Technology  
Department of Systems Engineering  
United States Military Academy  
West Point, New York 10996-1779  
gparnell@usma.edu  
&  
Toffler Associates  
gparnell@toffler.com

*The views expressed in this work are those of the authors alone and do not represent the views of the United States Air Force, the United States Army, the Department of Defense, or the United States Government.*

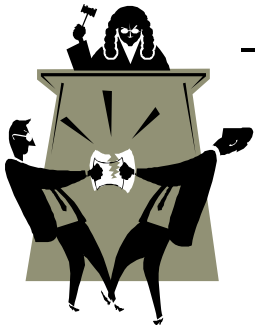


## Some Reasons Government DA is Hard

And this one had them all!!!!



- No profit motive - but BIG cost
- Cutting edge and beyond issues
- Massive scale
- Those responsible may be long gone
- Multiple Stakeholders - Many who don't agree
  - Public
  - Special Interest Groups
  - Contractors
  - Competing and Overlapping Jurisdictions/Regulators
    - Local, State, Regional Federal, Federal
    - What works for one, may not work in all
    - Varying interpretations of the law
- Large Uncertainties
  - Technical and political



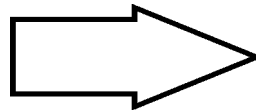


# CERCLA defines the environmental decision process.



## 9 Criteria Used to Evaluate Environmental Remediation Strategies for Superfund Sites

We evaluated technologies relative to the Balancing Criteria

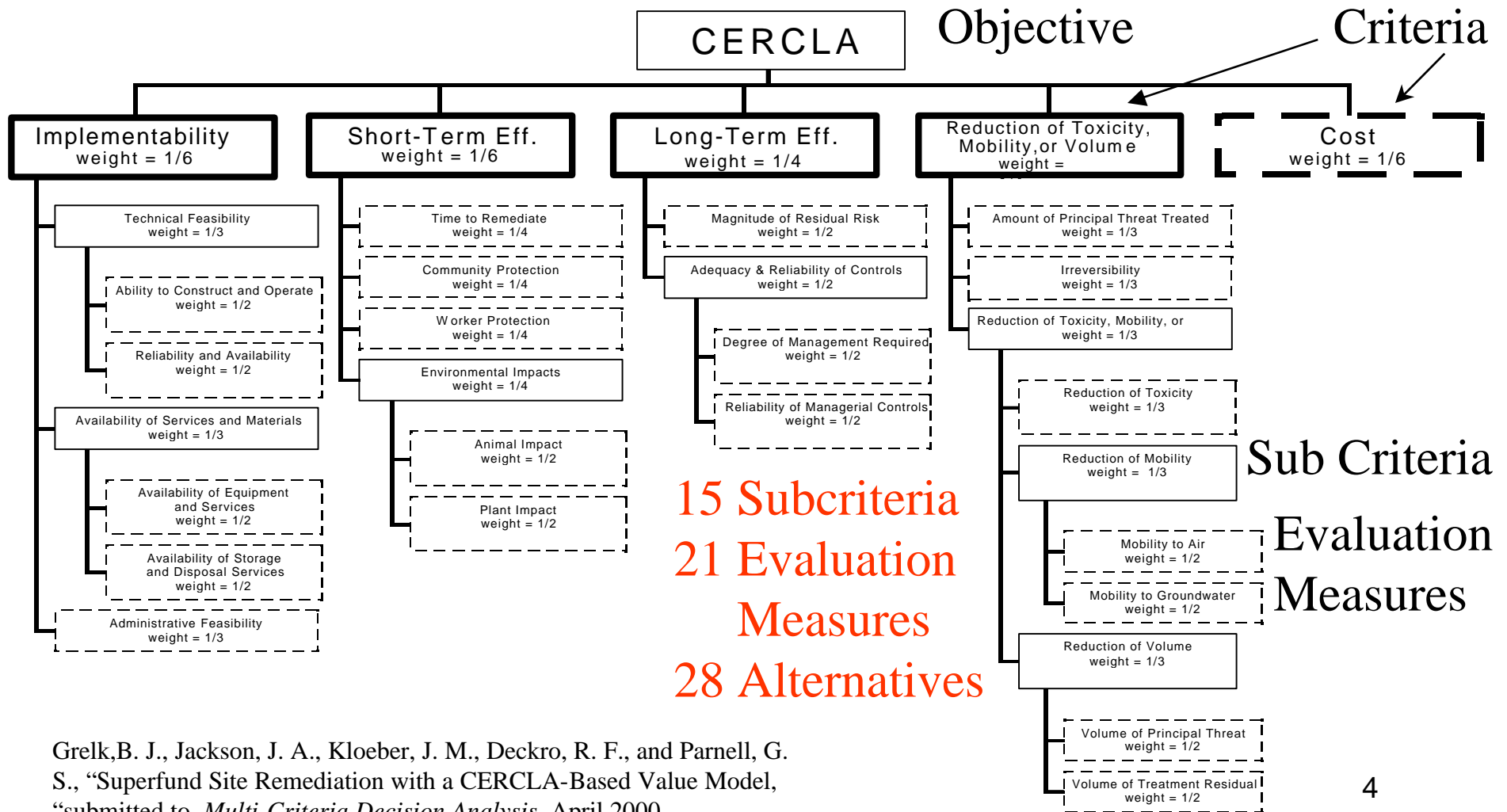


Comprehensive Environmental Response, Compensation, and Liability Act

- **Threshold Criteria:**
  - Regulation Compliance
  - Overall Protection of Human Health and the Environment
- **Modifying Criteria:**
  - State Acceptance
  - Community Acceptance
- **Balancing Criteria:**
  - Implementability
  - Short-Term Effectiveness
  - Long-Term Effectiveness
  - Reduction of Toxicity, Mobility, or Volume Through Treatment
  - Cost



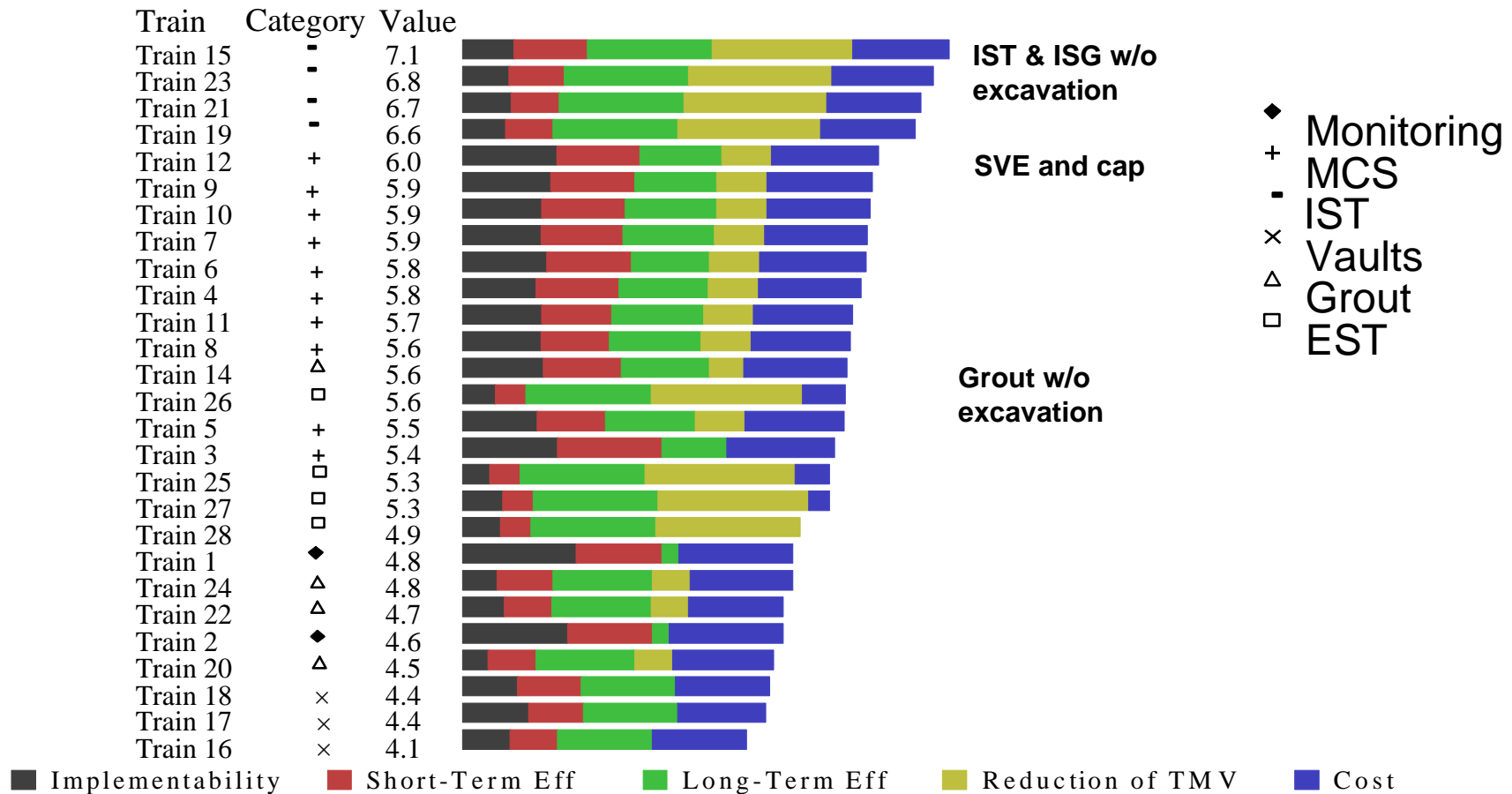
# A Gold Standard Multiobjective Value Model was developed based on CERCLA



Grelk, B. J., Jackson, J. A., Kloeber, J. M., Deckro, R. F., and Parnell, G. S., "Superfund Site Remediation with a CERCLA-Based Value Model," submitted to *Multi-Criteria Decision Analysis*, April 2000

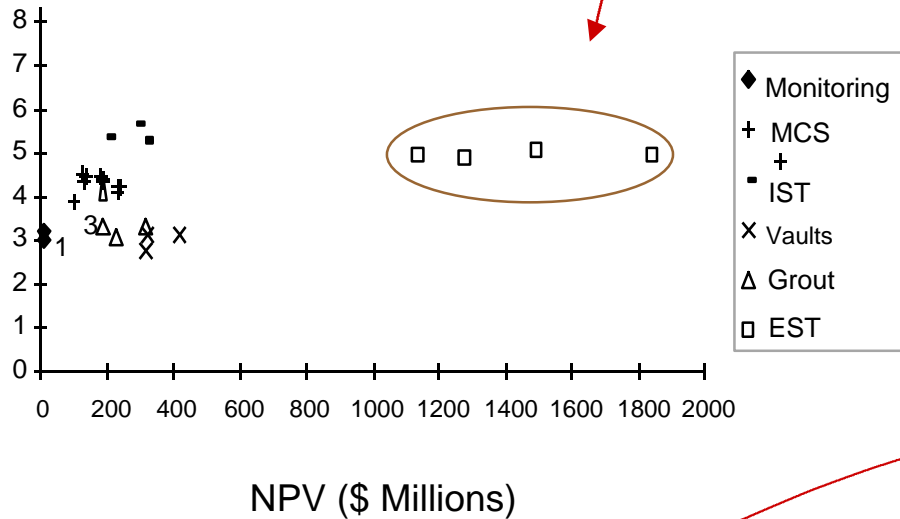


# Environmental remediation alternatives were evaluated using multiple objective decision analysis.





# Effectiveness vs. Cost Plot provided significant insights.

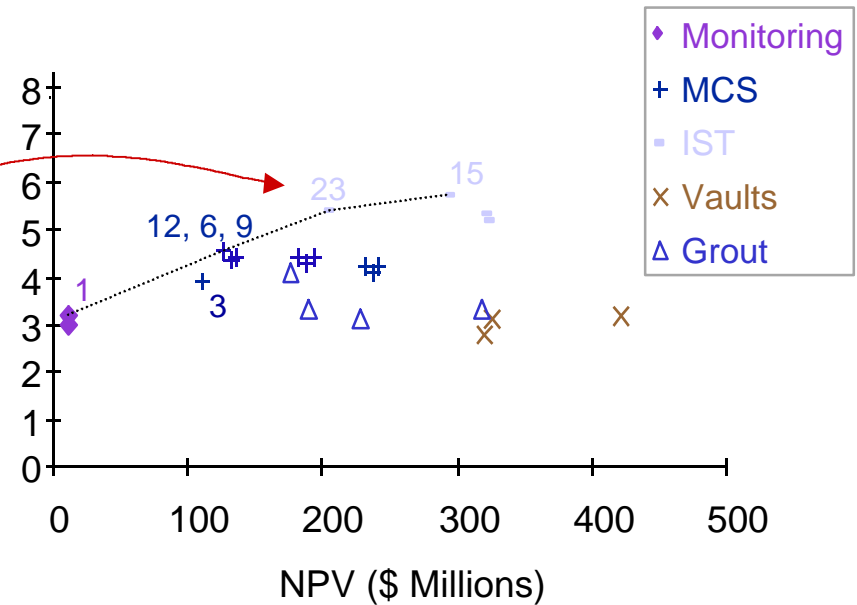


Without analysis

Highest cost/good value alternative selected on similar project

After analysis:

Highest value - affordable cost alternative preferred



**The best technology group (IST) had significant development risk.**



# Risk Analysis was an essential 2<sup>nd</sup> Phase Study



Poisson Thinning Process

$$P \{ N ( R ) = k \} = \frac{e^{-I} I^k}{k}$$

If  $k = 0$ , then

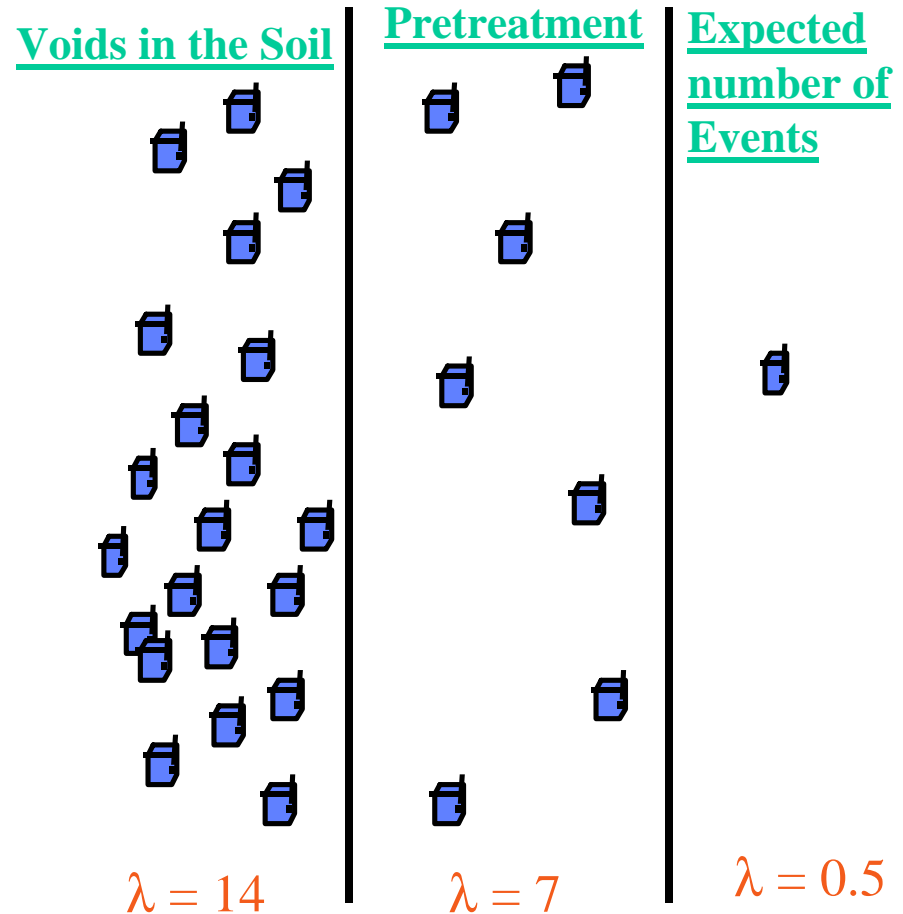
$$P \{ 0 \} = e^{-I}$$

From this,

$$I = -\ln(1 - P\{N(R) \geq 1\})$$

Combining analytical and graphical methods helped establish both **credibility** and **insight**.

Number of Events with Risk of Accident



Parnell, G., Frimpon M., Barnes, J., Kloeber, J., Deckro, R., J., Jackson,, "Saftey Risk Analysis of an Innovative Environmental Technology," *Risk Analysis*, Accepted June 2000



# Summary



- **We have supported decision-makers with several studies based on this methodology**
  - **Developed credible, traceable basis for decision-making**
  - **Influenced the technology test program**
- **We face(d) several challenges**
  - **Length of the decision process**
  - **Delays in the project**
  - **Changes in site management**
  - **Changes in government and contractor personnel**