Société Canadienne de L'Analyse de la Valeur
Canadian Society of Value Analysis

Value for Money Analysis for Surface Transportation Infrastructure: An Element of Value Engineering

October 27, 2008

David Lewis Ph.D.

HDR | Decision Economics

Uncertainty and Risk Matter

"To know one's ignorance is the best part of knowledge"

Lao Tzu

"Probabilities direct the conduct of the wise [person]"

Cicero

3

Rethinking the Fundamentals of Value

Principles

- Cost-benefit values as data and an expression of public beliefs
- Policy analysis and decision support as a deliberative process, not a desk study
- Mitigation and compensation as an integral dimension of the welfare maximization process
- Risk and probability as a subjective as well as an objective phenomenon
- = The New Cost-Benefit Analysis

4

Business Case and Value for Money Analysis: Traditional Versus "New"

- Welfare economics versus Neo-Welfare Economics
- Traditional Cost-Benefit Analysis represents a decision criterion independent of public engagement
- The New Cost-Benefit Analysis judges results in terms of deliberative process
- A positive Cost-Benefit Analysis "desk" finding must be validated through discussion and consensus
- Majority dissent -- the Cost-Benefit finding is refuted
- Finding also refuted if a *minority dissents;* minority dissent interpreted as need for further options, including compensation provisions for damaged minorities
- Only options that yield consensus without minority dissent regarded as welfare improvements

5

Values

- With traditional Cost-Benefit Analysis, values (mobility, life, health, environment, time, amenity …) are measured from historical data using either revealed or stated preference (contingent valuation) empirical methodologies
- The new Cost-Benefit Analysis recognizes that values take shape during the process of discussing prospective change
- Empirically derived estimates from historical data are not "data," but points of departure in a discursive, deliberative process

6

Social Values and Mental Heuristics

- Problem: Individuals are "hard-wired" with certain mental heuristics that lead to biased forms of reasoning, especially in matters of complexity
- Such biases have the effect of prompting people to make choices that are inconsistent with their own beliefs, values and preferences
- Applied as a procedure of facilitated discourse, Cost-Benefit Analysis offers a means of liberating "the communicative instinct" while helping individuals avoid the mental heuristics that give rise to unintended reasoning biases
- Risk analysis key to effective facilitation

7

Risk Analysis as a Facilitation Tool: Two Kinds of Facilitation

THE FREQUENTIST MODEL

- Probability of an event is the value to which the long run frequency of its occurance converges as the number of trials increases

THE PERSONALIST, OR BAYESIAN MODEL

- Probability is the degree of belief that a person has it will occur, given all the relevant information currently available to that person

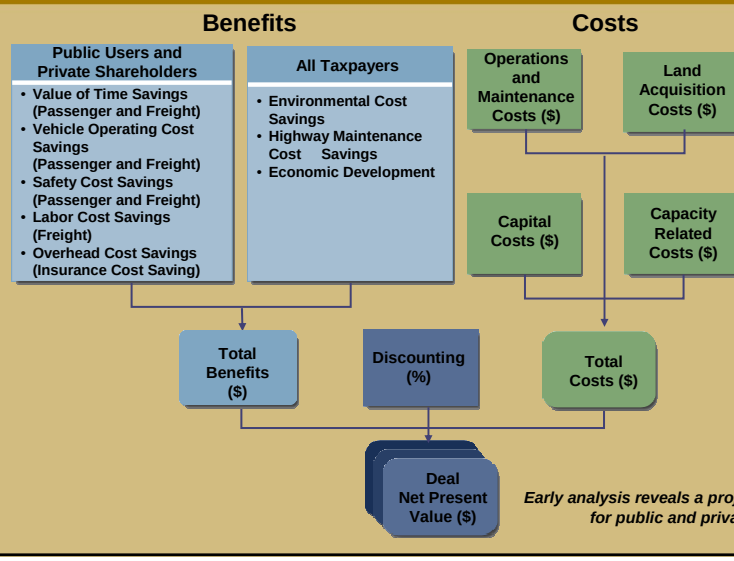
8

Making the New VfM/Cost-Benefit Analysis Operational

- Risk Analysis and Value Engineering
  - *Broadly applicable multi-step process used to support and enhance investment planning, forecasting, design, negotiation …*
  - *Enables the identification and enumeration of risks inherent in any decision or design problem*
  - *Embraces the knowledge of stakeholders*
  - *Facilitates consensus*

9

The Underlying Model



Early analysis reveals a project's net value for public and private participants

10

The Private Sector Component

	Public Partners				Private Partners		
	Expenditure/ Investment	Return on Investment	Value in Savings and Benefits	Risk Adj. ROI	Expenditure / Investment	Return on Investment	Risk Adj. ROI
Option 1	0				$300 M	20%	3%
Option 2	$50 M	40%	$600 M	35%	$250 M	30%	10%
Option 3	$100 M	30%	$600 M	22%	$200 M	50%	20%

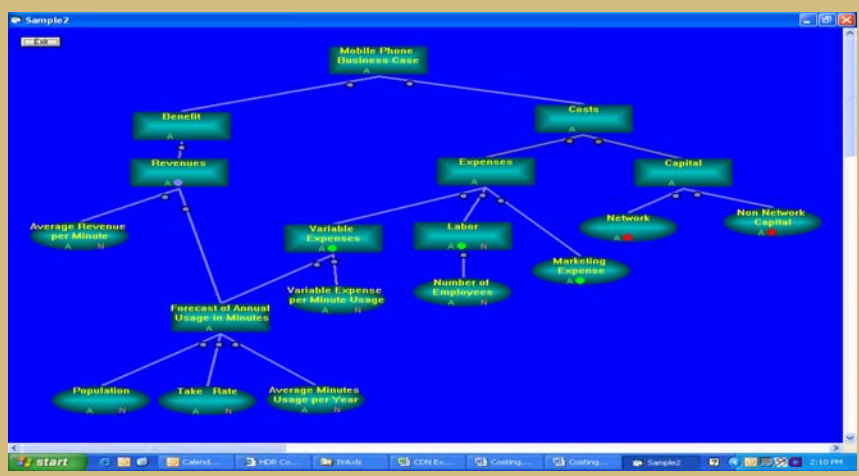
Basis for Financial Arrangement

Early analysis assures win-win

The Multi-Step Process

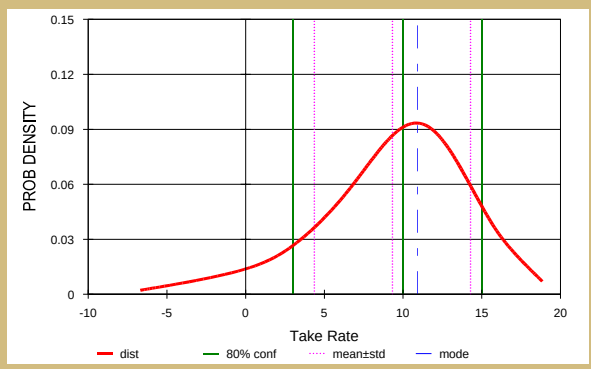
1. Identify structure and logic of the risk domain
2. Enumerate probabilities (Frequentist model)
3. Facilitate consensus probabilities (Bayesian model)
4. Identify outcome probabilities and decision risk
5. Facilitate risk management

- Step 1: Structure and Logic Model

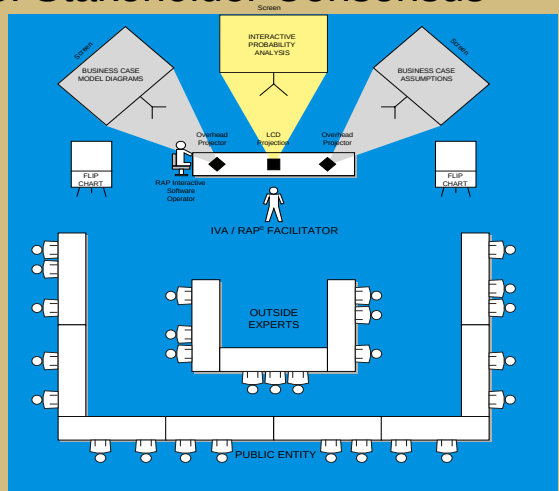


- Step 2: Data Assumptions

Variable	Base Value	Low Value	High Value
Growth Rate, %	10%	0%	15%



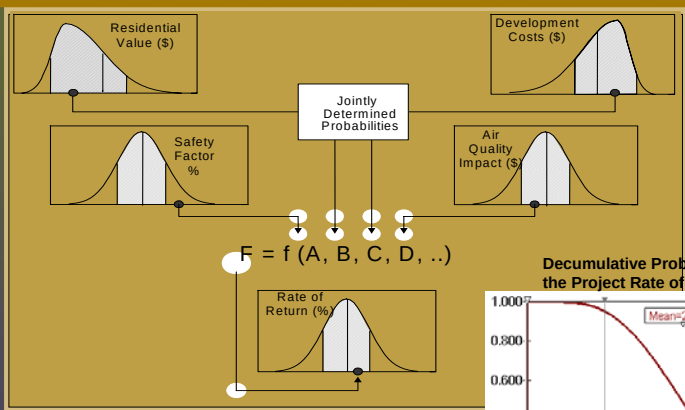
- Step 3: Stakeholder Consensus



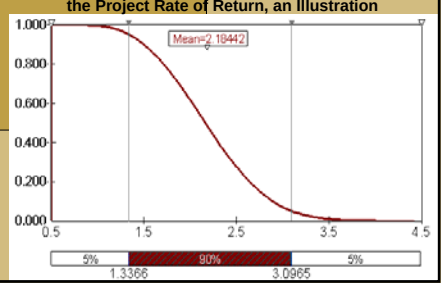
Step 3 - RAP Session: Applied Bayesian Risk Elicitation

- Review structure and logic models and forecasting assumptions with a panel consisting of:
  - *Engineers, Scientists, etc.*
  - *Stakeholders*
  - *Project Managers*
  - *Economists*
  - *Others*
- Revise structure & assumptions and facilitate consensus

Step 4: Risk Simulation

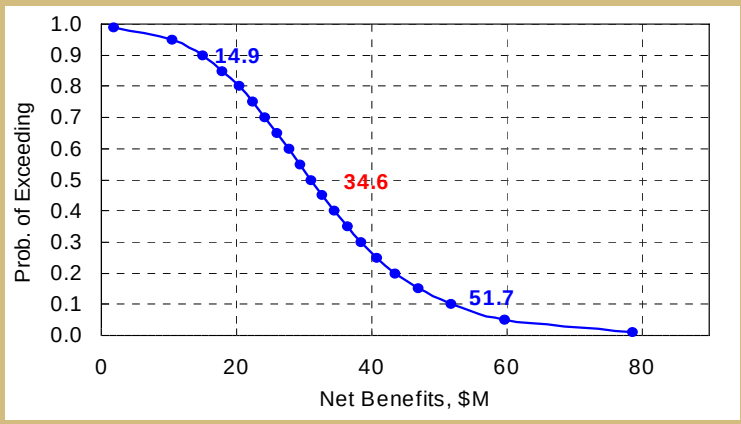


Decumulative Probability Distribution for the Project Rate of Return, an Illustration



Interpreting Results and Risk Assessments

Net Benefit Probability Distribution, PV $ Million



Case Study
Metro Road Toll Lanes, Phoenix, AZ

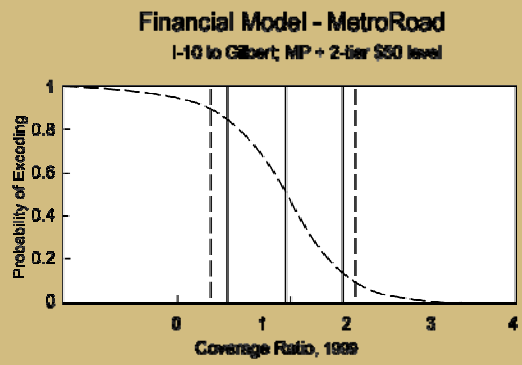
- Proposal – widen Superstition Freeway in east Phoenix with tolled lanes in both directions
- HDR|HLB conducted third-party risk assessment of traffic, revenue, costs, project risk and financial ratios
- P3 found viable: but too late in the process

Involve decision makers early in process to obtain financing buy-in

19

Metro Road: Financial Model

- Risk analysis indicates that coverage ratios satisfactory at no more than the 50 percent probability level
- Investors would incur 80 percent probability of coverage ratio falling beneath investment-grade level



20

Metro Road: Early Analysis Would Have Shown

- State participation at approximately 30% would bring private equity and bond market to the table
- Cost-benefit analysis would have demonstrated 22% public ROI
- Had information been available earlier, the State could have developed successful P3 and saved $200+ million

21

Case Study
Waycross, GA Track Relocation

- The project:
  - Removal of track, opening downtown for development
  - Removal of 13 grade crossings
- GRADEDEC/RAILDEC results
  - Safety, congestion, and economic growth
  - Development of state/city/county
  - Productivity gains for railroad

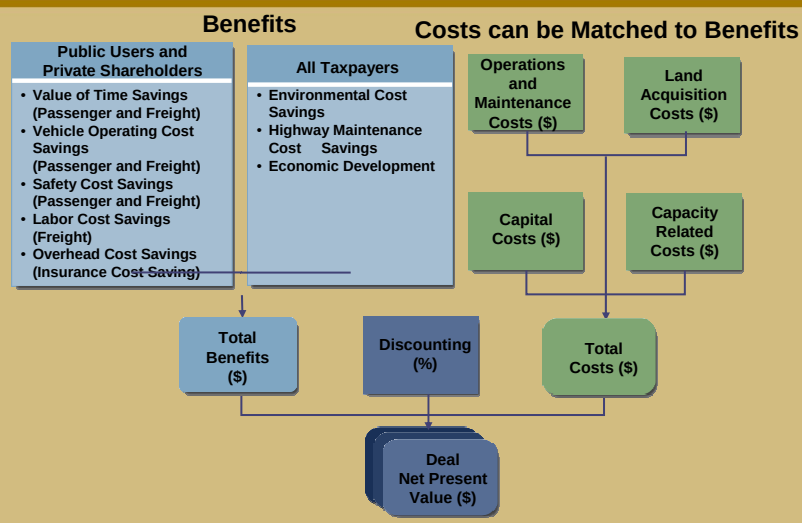
22

Waycross, GA Track Relocation
Win-Win

	Government Partners			Railroad		
	Expenditure/ Investment	Benefits	Net Benefits	Expenditure/ Investment	Benefits	Net Benefits
Option 1	0		-	$88 M	$65 M	($23 M)
Deal Option	$51 M	$90 M	$39 M	$37 M	$65 M	$28 M

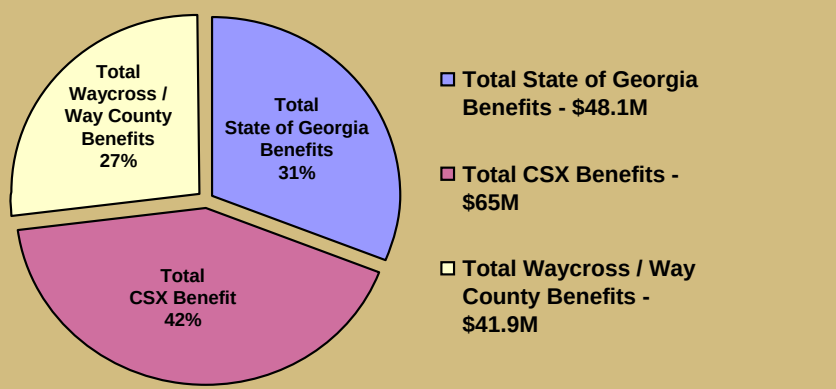
Basis for Financial Arrangement

Analysis Reveals Value for Public and Private Stakeholders



Early analysis reveals a project's net value for public and private participants

Waycross, GA Track Relocation



Costs $88M Benefits $155M

Software Demonstration