Risk-Based Investment Decisions

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To Risk or Not to Risk

- “The revolutionary idea that defines the boundary between modern times and the past is the mastery of risk: the notion that the future is more than the whim of the gods and that men and women are not passive before nature.” – Peter Bernstein
- In other words,
  - we can measure risk
  - manage it
  - prepare for it

What Do We Mean by Risk?

- "Risk is the positive or negative effects of uncertainty or variability upon <u>agency objectives."</u>
- It includes
  - Uncertainty
  - Variability
  - Threats
  - Opportunities

Risk: The Third Pillar

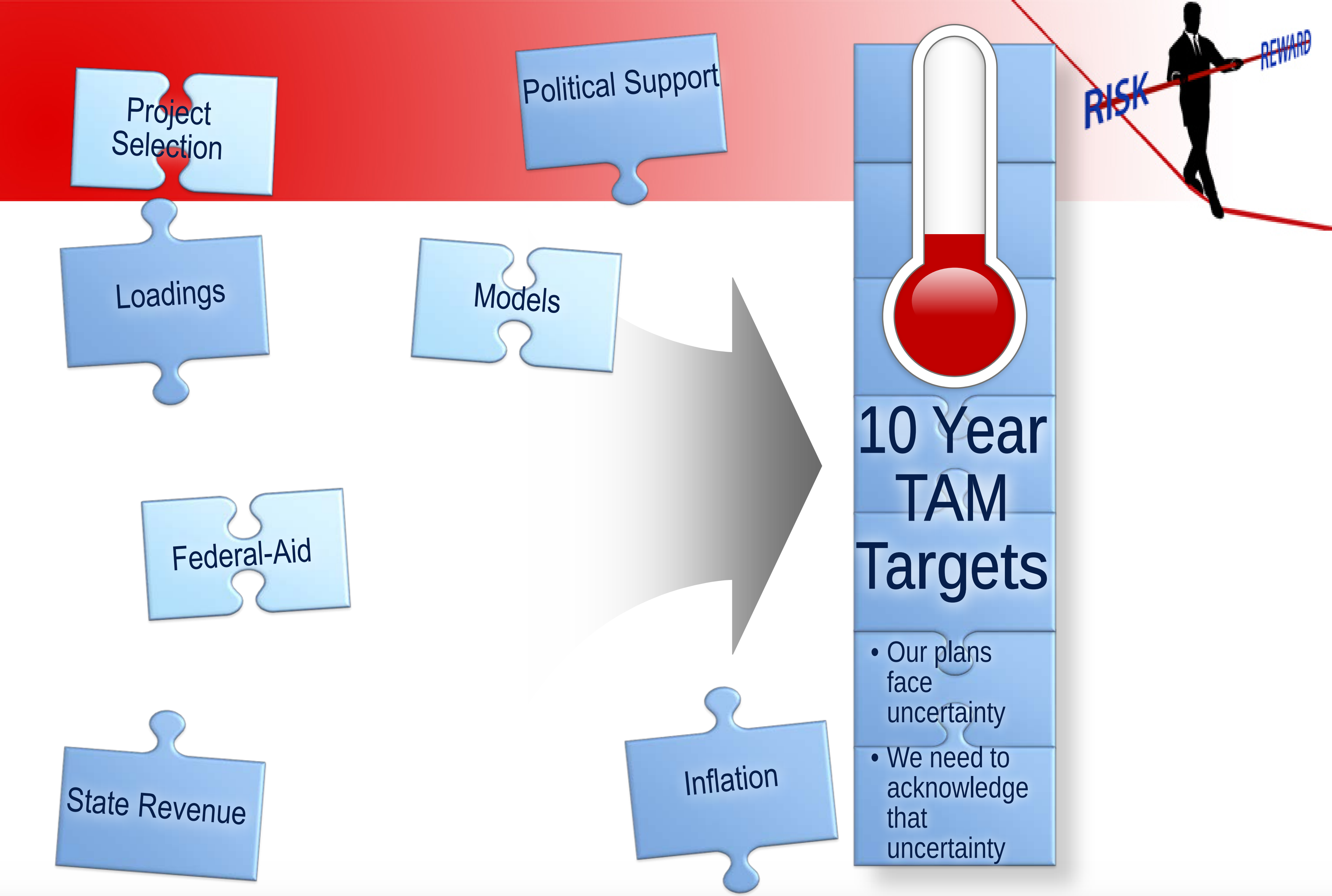
- Asset and performance management drive performance
- Risk management is an enabler
- It identifies, mitigates uncertainty to objectives

Why Manage Risk?

- Risks are inevitable
- If something is inevitable, it's irresponsible to ignore it
- We practice either risk management or crisis management

Risk Parallels Performance

- As performance expectations grow, so does risk
- No performance target, little chance of missing it
- With long-term, specific performance targets, risk increases


Project Selection
Political Support
RISK
REWARD
Loadings
Models
Federal-Aid
State Revenue
Inflation
10 Year TAM Targets
• Our plans face uncertainty
• We need to acknowledge that uncertainty

Political Support

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10 Year TAM Targets

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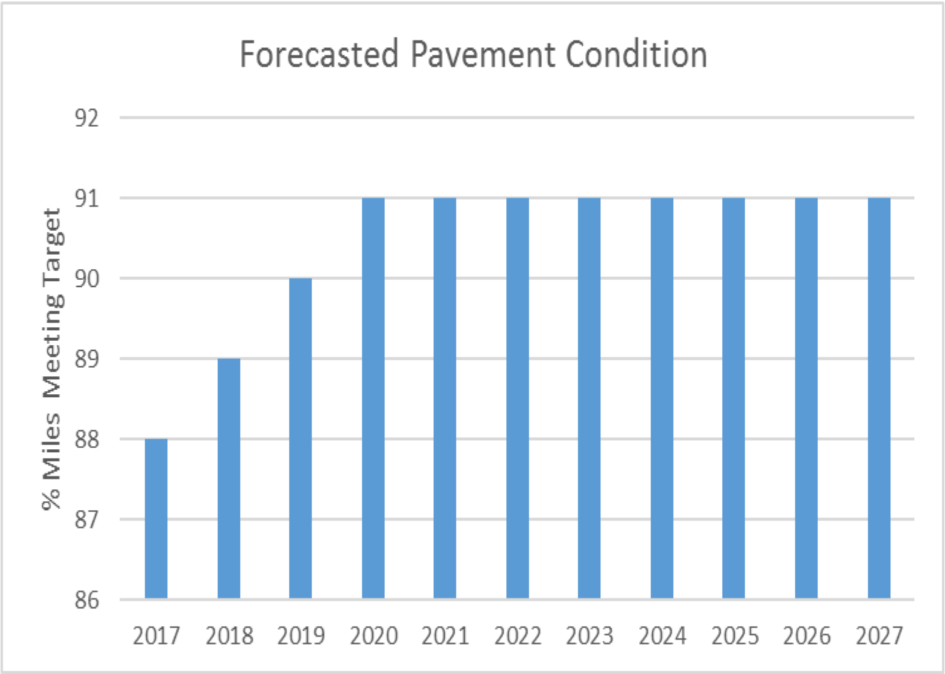
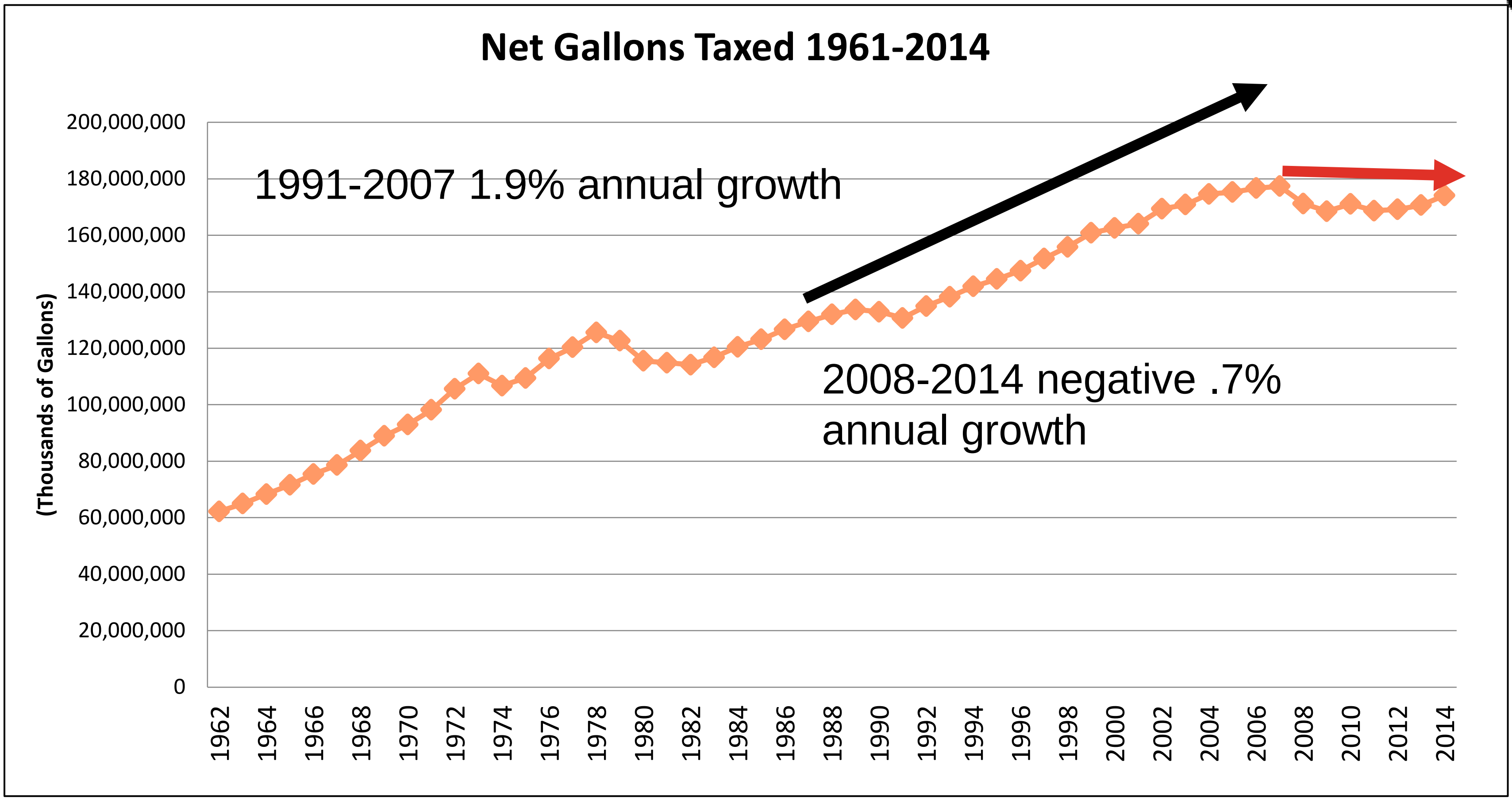
- We need to acknowledge that uncertainty

Scenario

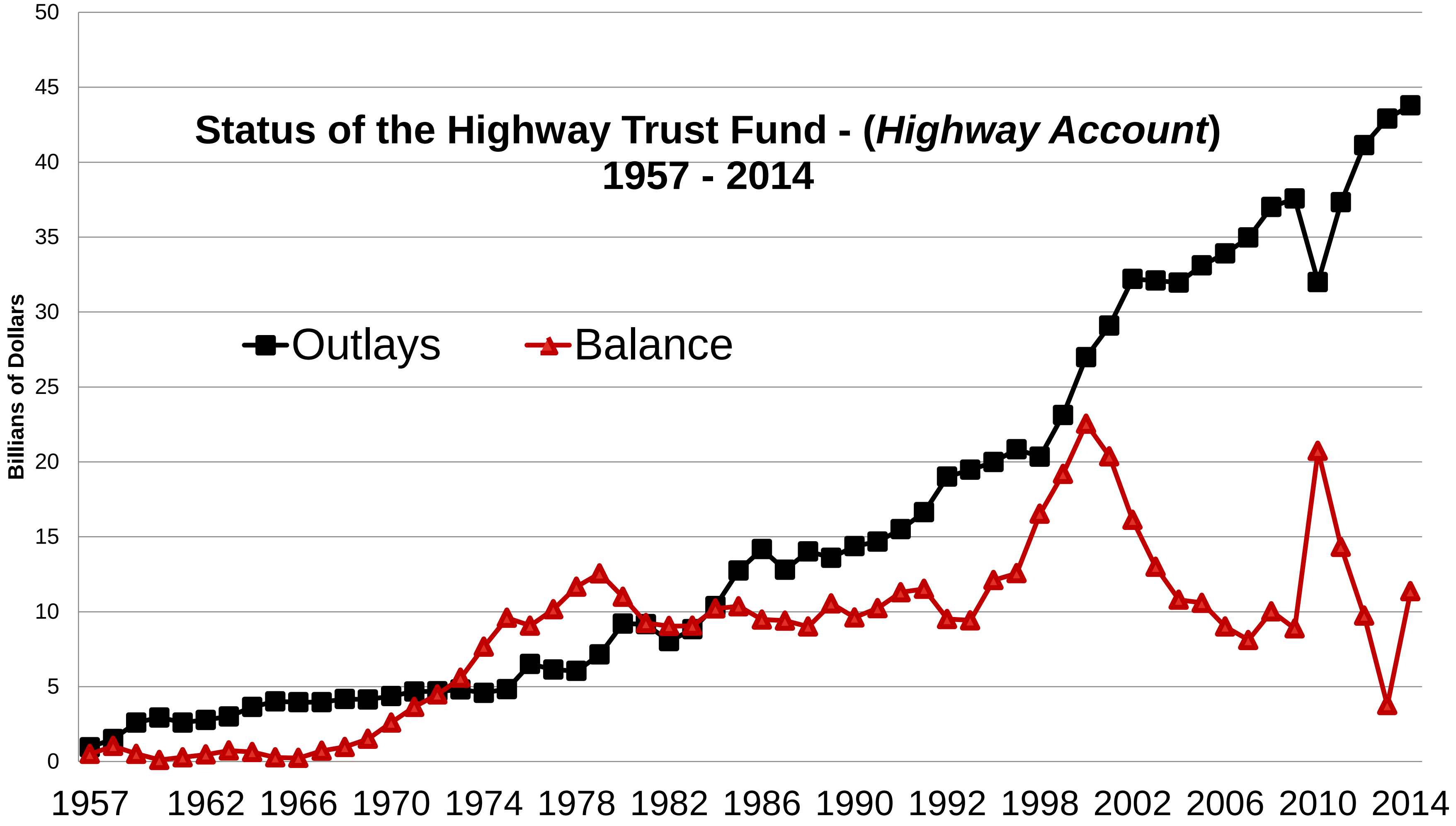
- Agency assumes $600 million annually in current dollars will achieve pavement target for 10 years
- Assume
  - 3% inflation
  - Stable revenue
  - Accurate model



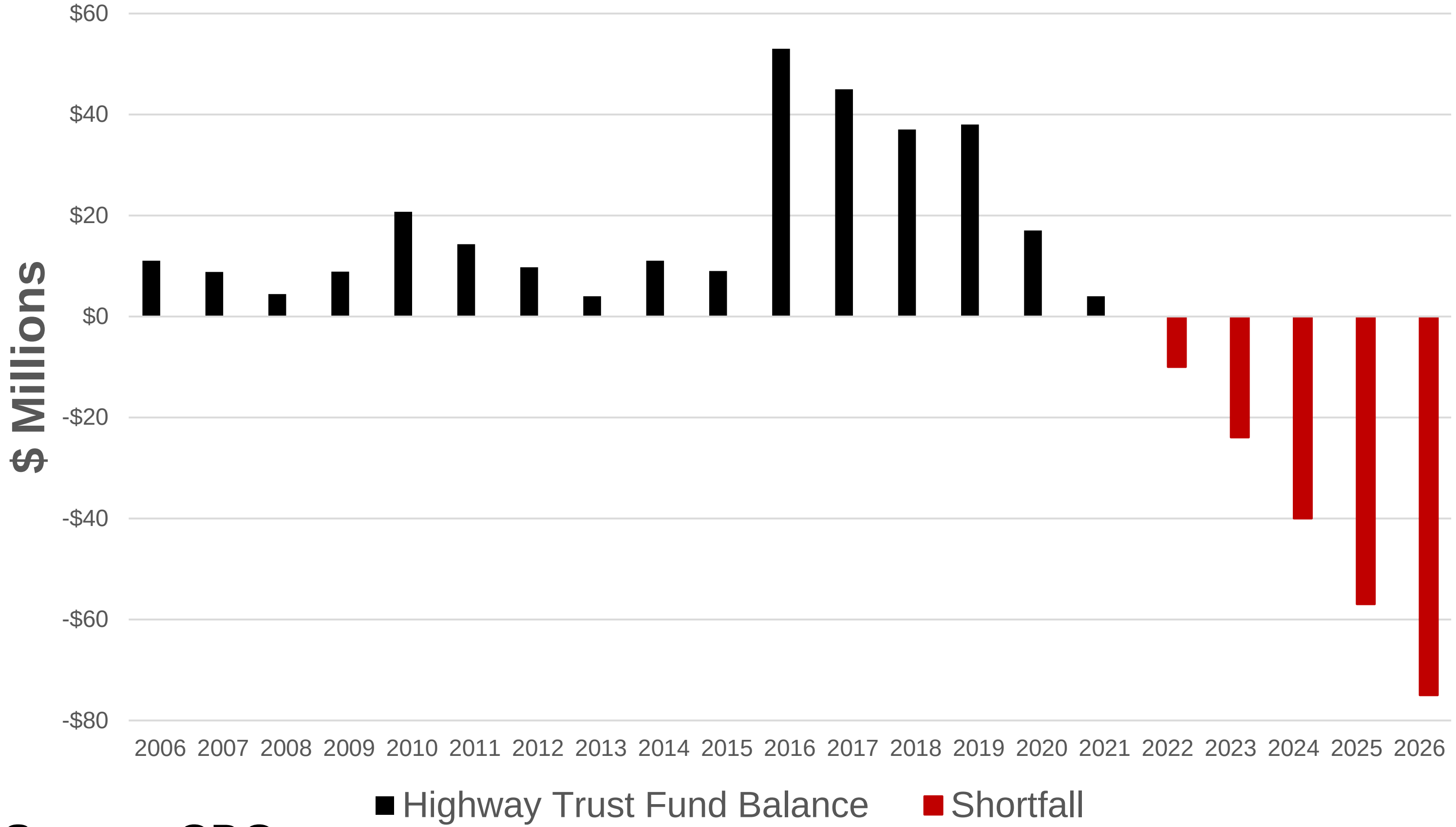
Fuel Consumption Trends



Highway Trust Fund Trends

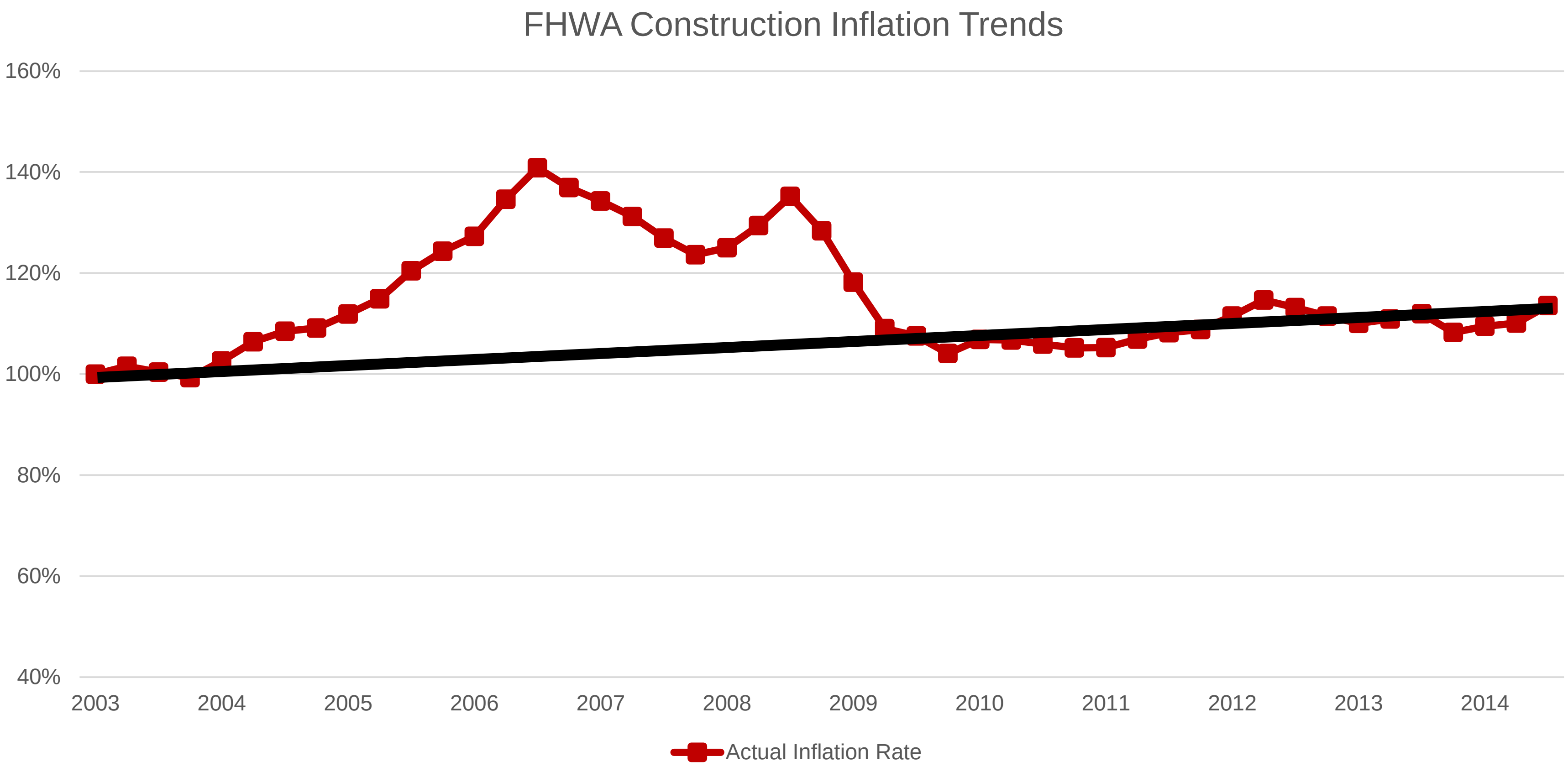


Trust Fund Forecast



Source: CBO

Construction Price Trends

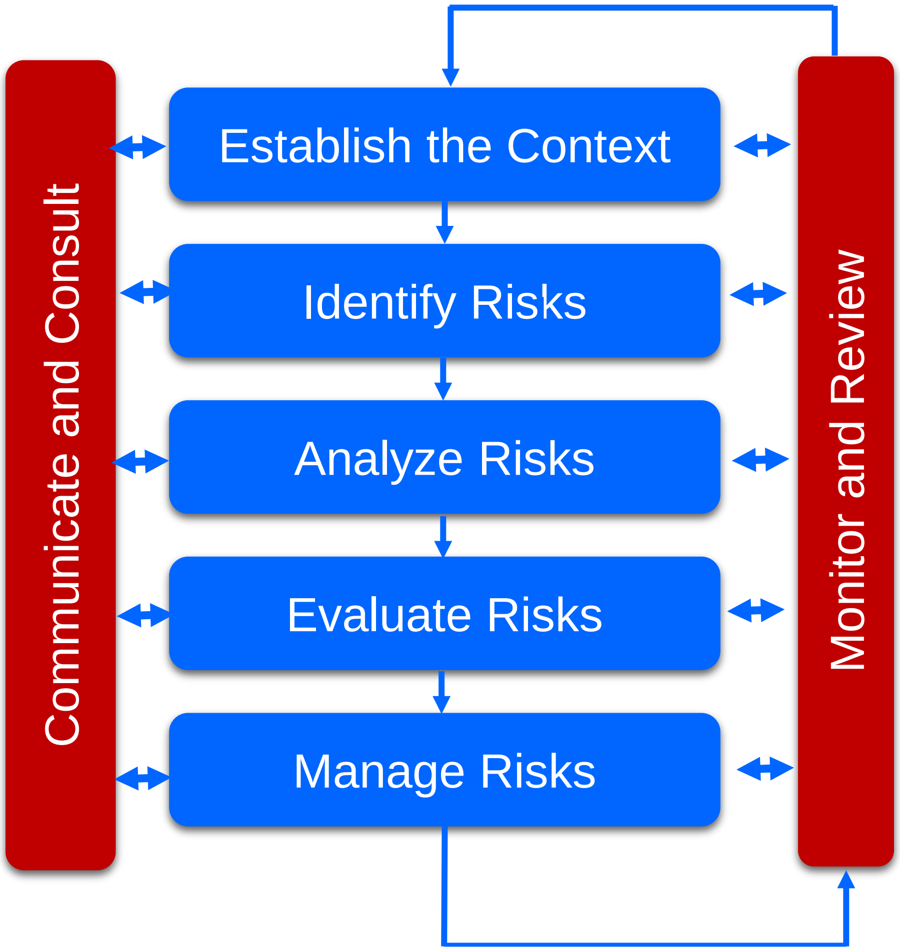


Elements of the Guide

- Why manage risk?
- Policies, tools, process
- A sample risk policy
- How to integrate risk into planning, programming, decision making
- Tools for risk workshops
- Strategies for sustaining risk efforts
- Advanced tools

ISO-Based Risk Process

- Guide explains need for continuous monitoring, communication
- Risks evolve as circumstances change
- External stakeholders need updates



Risk Evaluation Tools

Likelihood and Consequence Matrix, or the Risk Matrix						
Likelihood		Values	Risk Scores			
	Almost Certain	5	5	50	200	350
	Probable	4	4	40	160	280
	Possible	3	3	30	120	210
	Rare	2	2	20	80	140
	Very Rare	1	1	10	40	70
			Values			
			1	10	40	70
			Low	Moderate	High	Severe
			Consequences			

Managing Risk at All Levels

- Guide explains how to cascade risk management to all levels of organization
  - Enterprise
  - Program
  - Project
  - Activity

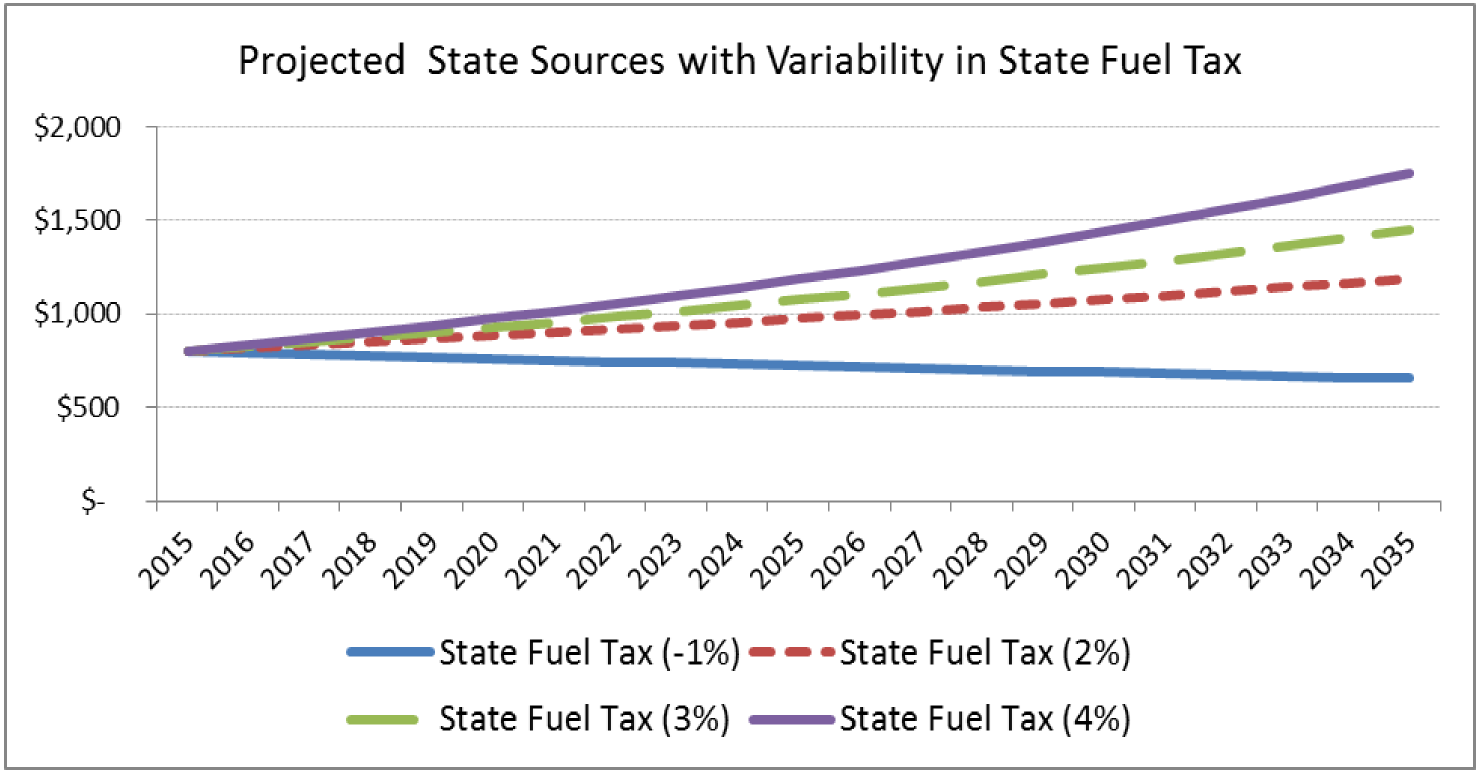
Risk Management Tools

NCHRP Guide for State DOTs: Managing Risk across the Examples of Tools to analyze the impact of risks over the long-term (from simple to more complex)

- Simple Excel Tools
- Excel Tools with Delphi
- Monte Carlo Simulation
- Risk Management Software such as, @Risk
- Others

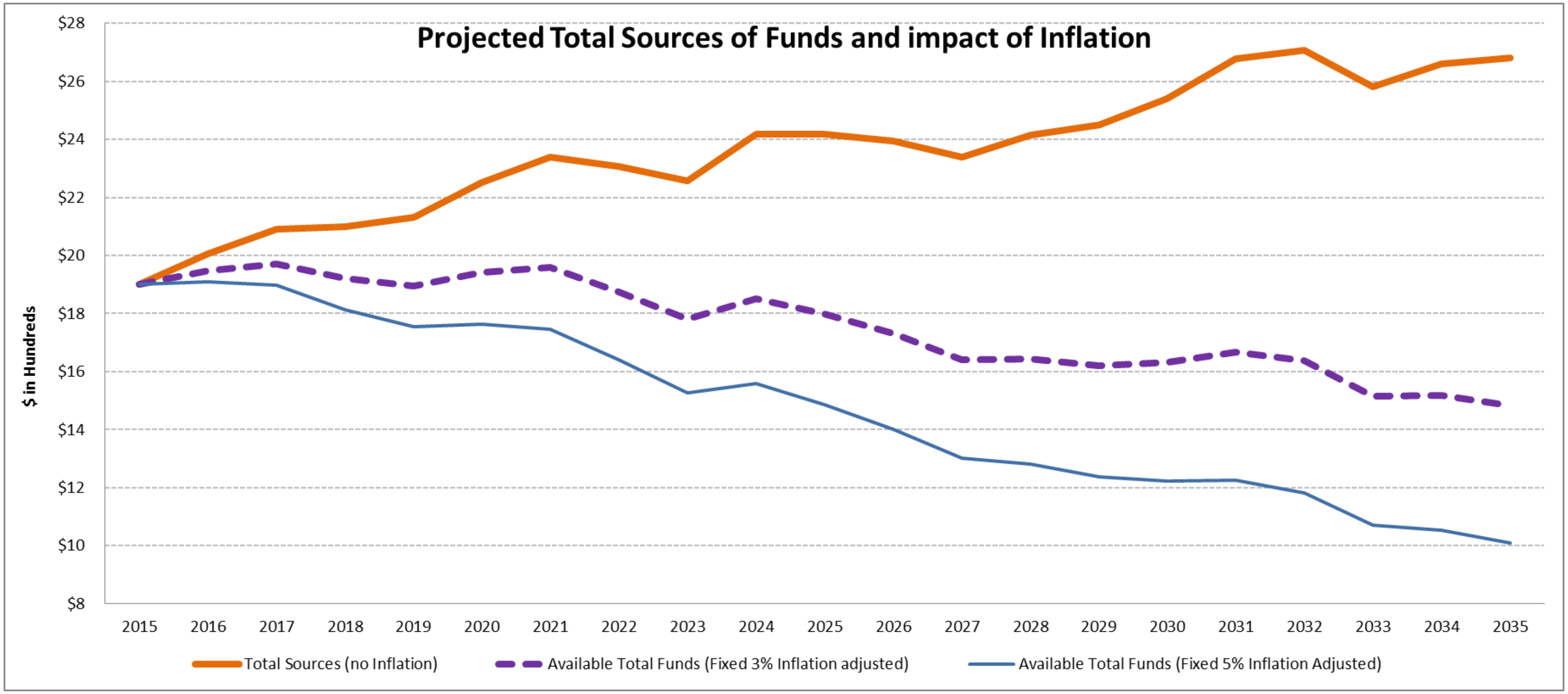
Variability in Sources

- Risk due to variability in revenue projections can result in budget gaps that can impact the ability to deliver the TAMP



Simple Excel Tools

- Shows impact of different levels of inflation on the funding sources that vary annually at random within certain ranges



Monte Carlo Simulation

- Monte Carlo Simulation - a common risk analysis tool used to analyze the impact of uncertainties

- Several online and commercial tools are available to perform such risk analyses, for example,

    - Vertex42.com
    - @Risk
    - Crystal Ball
    - Risk Solver
    - Risk Analyzer
    - Risk AMP Add-in for Excel
    - Etc.,…

Monte Carlo Simulation Results Summary Statistics

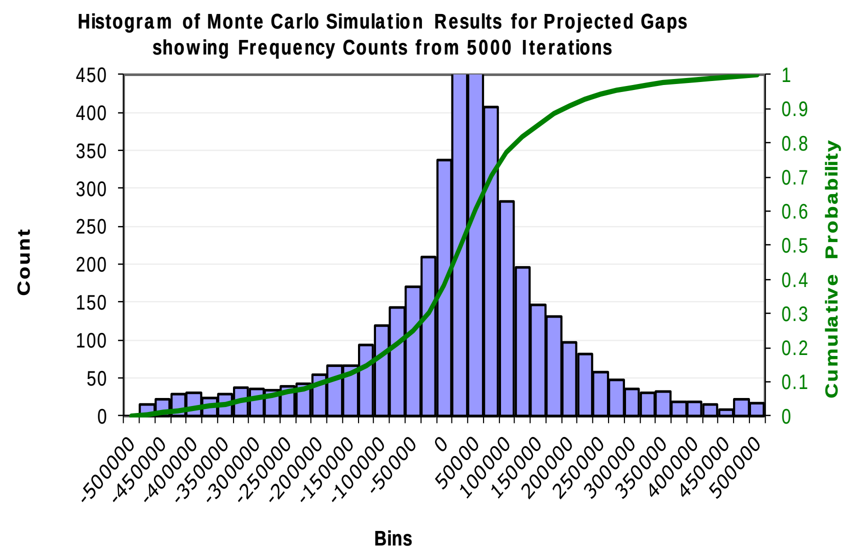
- The summary of results for the “simplified” DOT example shown below indicates a 62% probability that there will be a funding surplus
- Various other details can also be shown to facilitate decision making

Summary Statistics for Present Value of Projected Gaps for 10 Years

Sample Size (***n***):	4180
MEAN:	$14,572
STDEV:	$160,089

Probabilities

Pr(Gap > 0):		62%
Pr(Gap < 0):		38%
Pr(Gap <	$ (100,000) **)**	18%
Pr(Gap >	$ 100,000 **)**	23%
Pr(-100000 < Gap < 100000) =		60%



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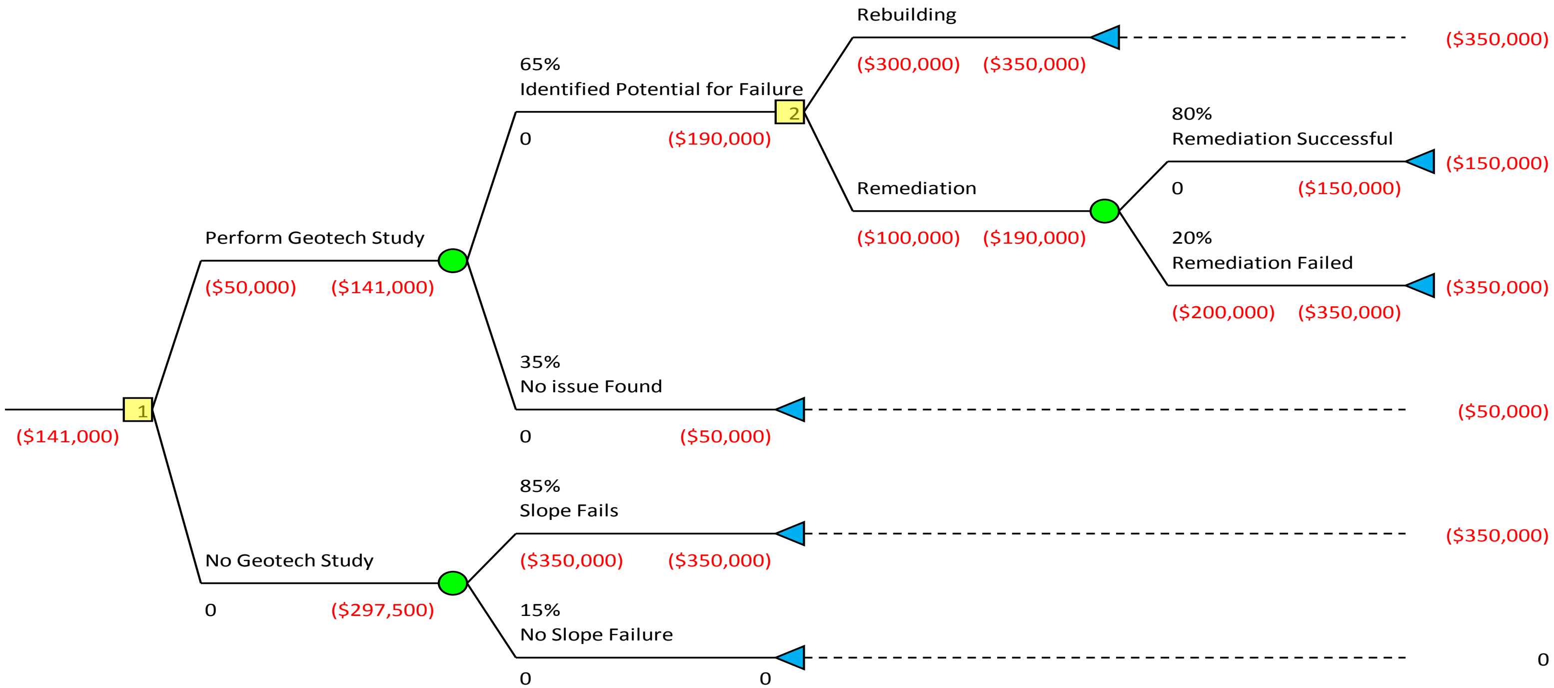
Note: A simple Google search yielded an example of Monte Carlo Simulation from Vertex42.com which was adapted to a sample “simplified” DOT scenario in the illustration shown

Decision Trees



- Compares and graphically presents possible outcomes of different choices

Conclusion

- Addressing risk adds realism, credibility to asset management forecasts
- Basic enterprise risk management can identify, summarize risks
- Off-the-shelf tools allow quantified analysis of probabilities of different investment scenarios

FHWA Risk Resources

http://www.fhwa.dot.gov/asset/pubs.cfm?thisarea=risk

Questions