2003 Annual Meeting

PBEE DECISION MAKING

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ISSUE SURFACING → MULTIOBJECTIVE FILTERS → RISK MGT OPTIONS → FINANCIAL ASSESSMENTS

ISSUE SURFACING

1 We'd better get better prepared

0 I'm not going to worry about this risk

For PBEE to be used, client must agree that the risk is worth attention. (This is not true for code-based design.)

PEER

ISSUE SURFACING

6 Case Studies

Three patterns found:

- NEAR MISS: Small crisis, vivid awareness of vulnerability/poor preparation for other risks
- CORE AT RISK: Core Technology Vulnerable
- COSTLESS GAIN: Opportunity to reduce risk cheaply as part of another project

RISK OF RUIN was a crucial heuristic in 5 of the cases

ISSUE SURFACING

Post-Nisqually Survey (n □ 832)

One-third “ants”; two-thirds “grasshoppers”

	%
Which o f the following two statements comes closest to <u>your personal</u> reaction to this earthquake?	
Our organization seems well prepared for earthquakes since we fared pretty well................	67%
Our organization needs to get better prepared since more serious earthquakes c an happen......	33

	Mitigations added after quake
Average number of mitigations....	0.9
% of firms mitigating................	34.4%

PEER

ISSUE SURFACING

Post-Nisqually Survey (n□832)

Results of Logistic Regression Analysis: Effects on New Mitigation Activity

Step	R_L^2	^{2}	df	Variables	b	s.e.
1	.076	33.76*		Constant	-2.458***	-.482
			18	Industry [a]	n.s.	
				Organizational age	-4.9E-5	.005
				Organizational size	.002	.002
				Risk perception	.012	.067
				Worry	.376***	.095
2	.199	58.62***		Disruption	.546**	.192
			5	Information search	1.590**	.333
				Prior preparedness	.025	.033
				Overconfidence	-.685**	.264
				Shake intensity	.065	.142
3	.222	11.50*		Shake x Disruption	.131	.324
			3	Shake x Information Search	-.099	.495
				Shake x Prior Preparedness	.125*	.058
				Shake x Overconfidence	1.222**	.403

* $p < .05$ ** $p < .01$ *** $p < .001$ (Significance levels calculated from Wald statistic)

Multiple-Objective Filters

Survey of 50 practicing engineers

In your last PBEE project (n=19)

How important were the following goals to the owner?

Scale: 1=not a priority; 5=main priority

	mean
Protect people.................................. ..	4.16
Avoid dow ntime after an earthquake...... .	3.89
Protect the value of the building........... .	3.05
Protect contents and inventory (other than computers and data)....................	2.67
Protect computer systems, data and files ..	2.33

Multiple Objective Filters

Survey of 50 Engineers

Clients' reasons for declining PBEE

Scale: 1=not important; 5=extremely important

	Mean	n
Desire to invest no more than is legally required...	3.62	21
Desire to minimize cost of engineering analysis and design...............................	3.62	21
Desire to minimize length time/business involved in renovation..........................	3.56	16
Cost of doing PBEE exceed the owner's anticipated benefits............................	3.47	19
Desire to follow legal prescriptions (i.e., code) in order to avoid liability............	3.42	19
Desire to invest no more in engineering than other similar firms invest...............	3.20	20
Belief that engineers overstate the probabilities and seriousness of earthquakes... ..	2.78	18
Doubt that serious quakes will occur while they still own the building................	2.73	15
Doubt that serious quakes will do serious harm to their building, contents, people.	2.62	16
Doubt that serious quakes will ever occur in their location..................................	2.43	14

Multiple-Objective Filters

6 Case Studies

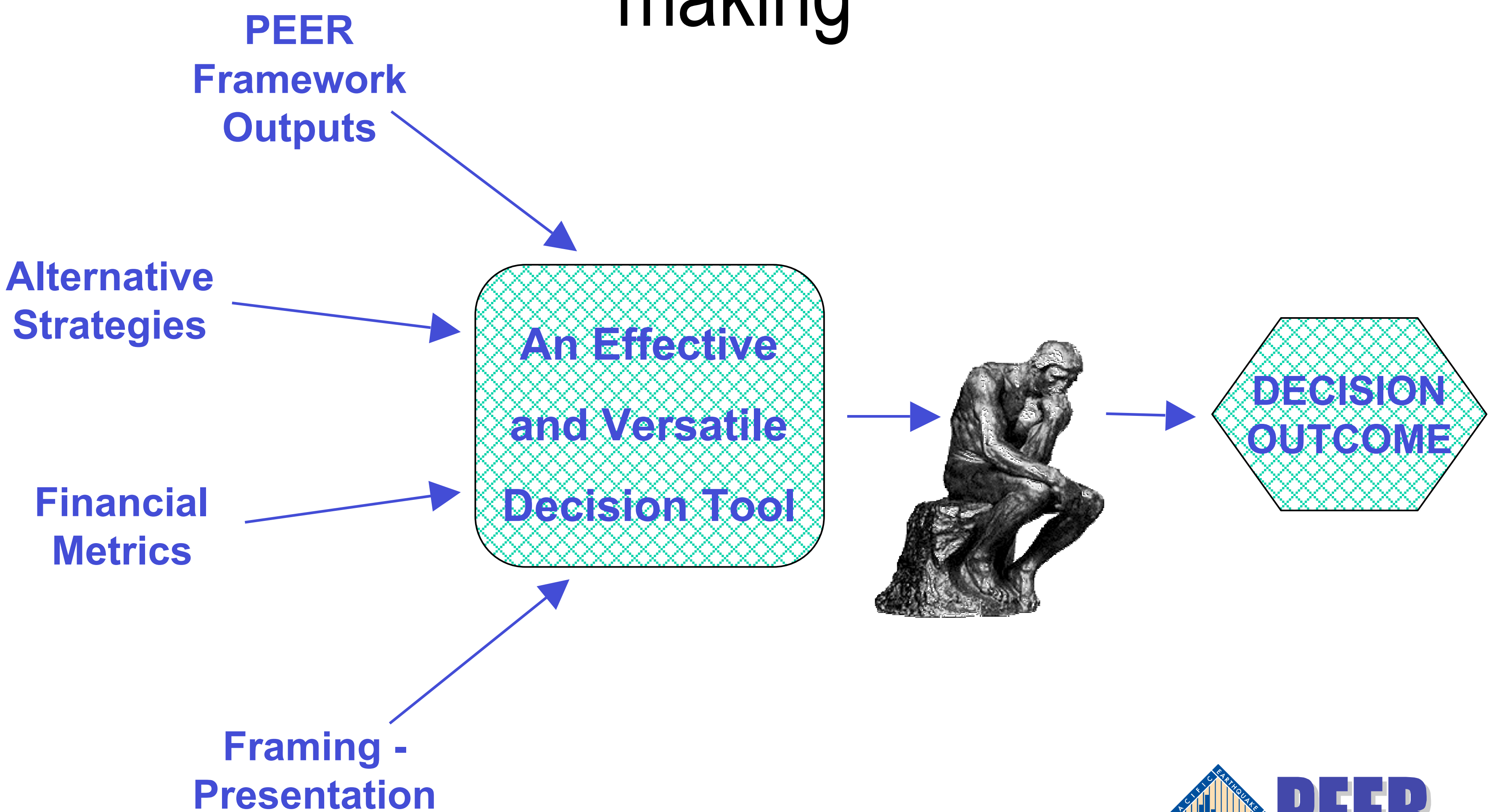
Major decision constraint in 4 cases:

Cost and disruption of mitigation could not be significant

In 1 case:

Cost could be significant, but not disruption

Financial Metrics & PBEE Decision-making

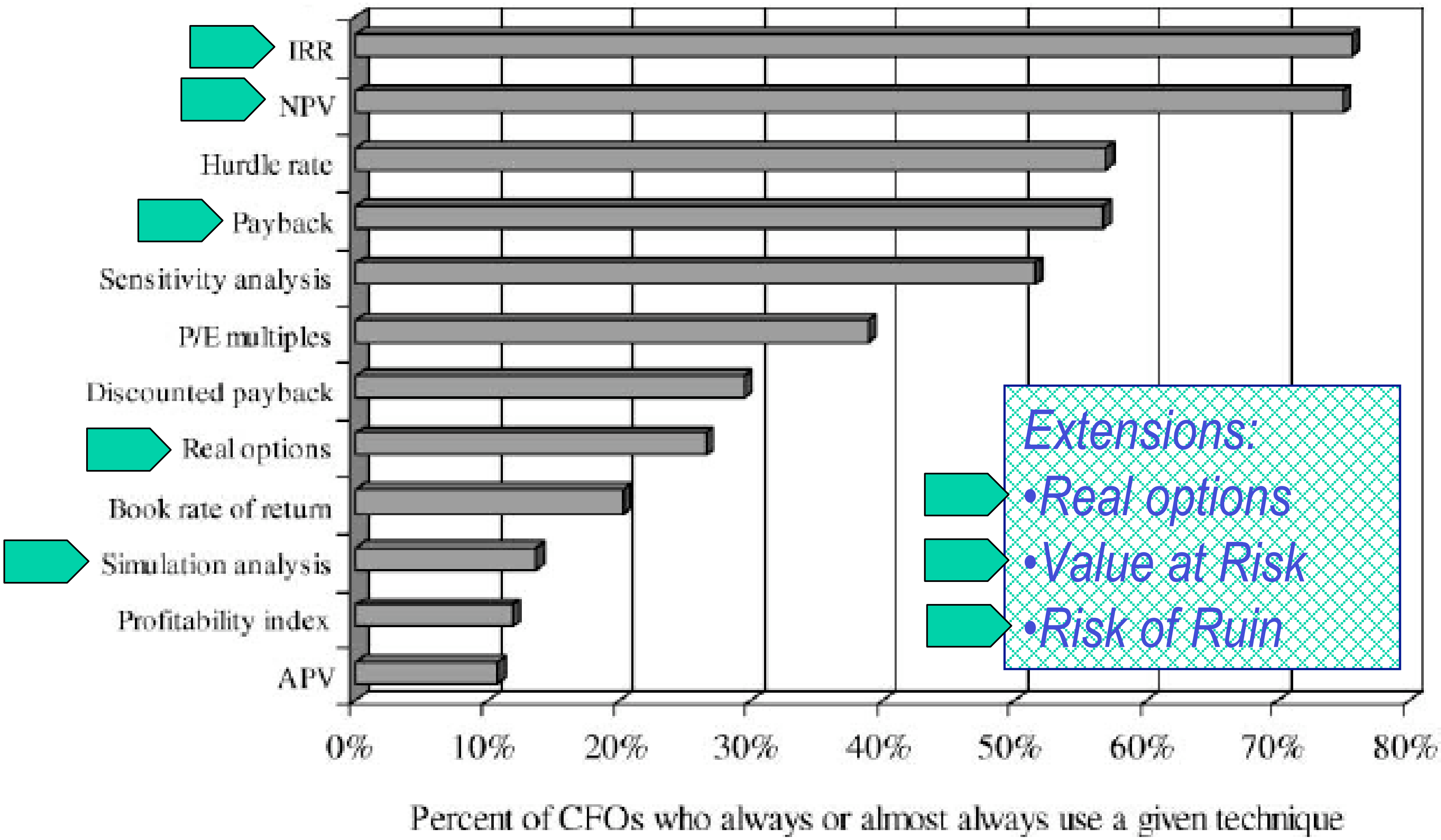


Financial Metrics & PBEE Decision-making

- Use methods and metrics familiar to the *non-engineer* decision maker
- Consider a comprehensive spectrum of mitigation and non-mitigation alternatives
- Leverage the richness of output from PEER framework to maximum extent
- Frame the mitigation decision analysis as a mix of financial and non-financial decision variables

Familiar decision methods and metrics

- Capital budgeting techniques

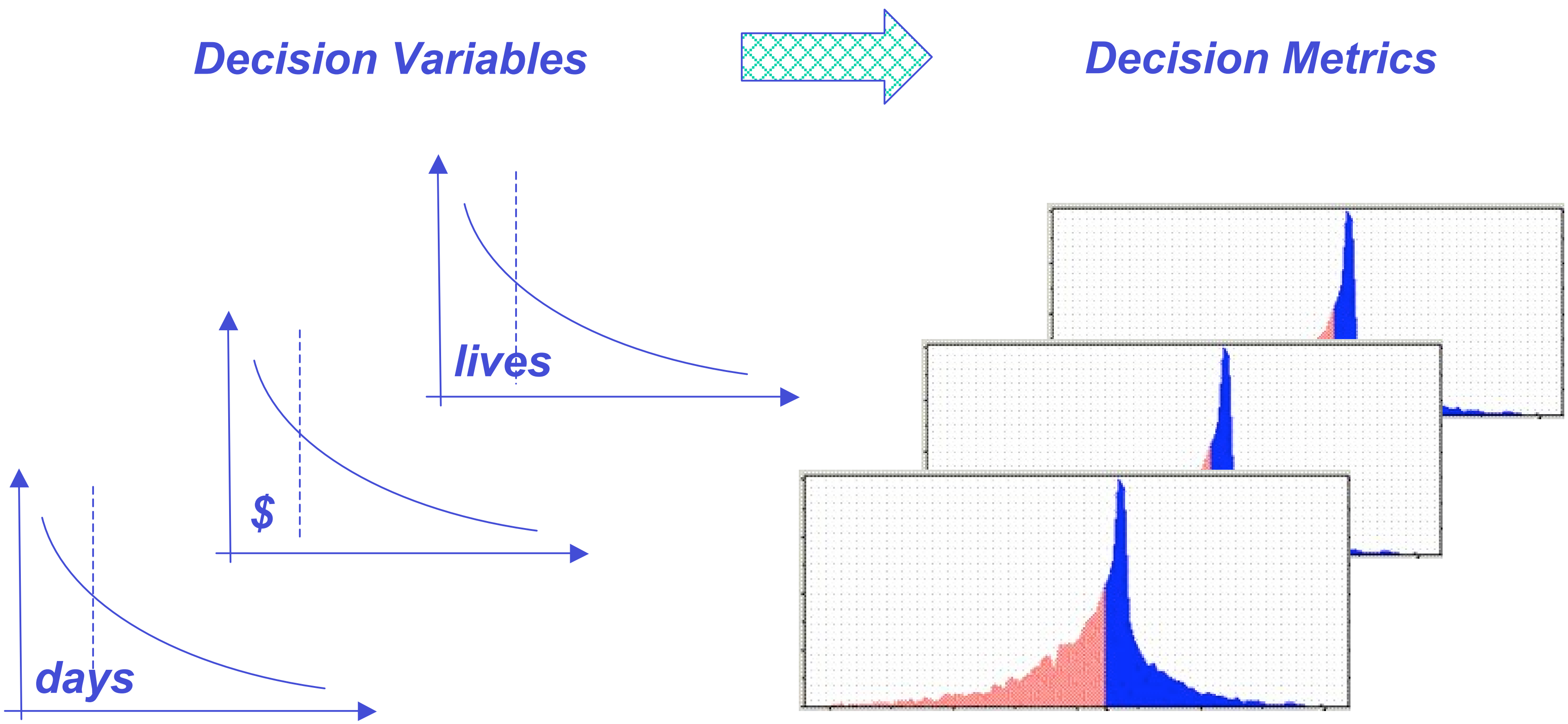


Comprehensive spectrum of alternatives

	Active – Anticipation	**Passive – Resilience**
Geographical	Risk Avoidance	Risk retention – Diversification
Physical	Structural Retrofit	Redundancy Building
Risk transfer	Insurance – CAT securities	Government Bail-out

Leverage the output from PEER framework

$$\lambda(\underline{DV}) = \iiint G(\underline{DV} \mid \underline{DM})\, dG(\underline{DM} \mid \underline{IM})\, d\lambda(\underline{IM})$$



Framing: financial and non-financial DVs

	Structural NPV	Structural IRR	Downtime	Injuries	Fatalities	Simulated Probabilities
No Retrofit	$0	13.0%	4.2 days	1.64	0.40	x%
Moderate retrofit	$69,093	16.6%	2.1 days	0.80	0.19	y%
Extensive retrofit	-$40,088	11.9%	1.1 days	0.43	0.10	x%

PACIFIC EARTHQUAKE ENGINEERING RESEARCH PEER

	PEER-funded projects	Prior test-bed meetings	ATC 58 Project workshop	Features of the financial model
Methodology	"Investor-based" decision making explictly addressing costs and benefits at different levels of seismic safety		Rigorous cost-benefit analysis	✓
	Tradeoffs between investing in seismic resistence or alternative forms of risk management			Insurance will be incorporated. Securitized risk transfer is not included. At the retail customer level (e.g. Van Nuys) not available.
	Consequences and tradeoffs among different levels of safety		Range of potential outcomes may be desirable.	✓
Relative vs. absolute	Consequences expressed in relative terms rather than absolute	Relative risk considerations		✓
Probability		Move from scenario analysis to more refined probabilistic statements	Probabilistic statements are not favorably received. Scenario analysis preferred. 90% confidence level.	The output is % probability of annual loss for three categories under various mitigation scenarios.
Decision Variables	Public safety: saving lives/avoiding injuries	Life-safety	Life losses (not the focus of discussion, though)	✓
	Cost of damage repair	Repair costs	Direct economic losses (especially down-time)	✓
	Cost of down-time	Down-time		✓
Time Horizon		Relevant time horizon needs to be considered	*Annual* probability is not desirable	Reduction in a*nnual* expected losses at different levels of mitigation investments is obtained
Externality	Consider externalities		Indirect economic losses	No. These are location/structure specific and hard to incorporate in a general framework. For Van Nuys externality data not available