

Project Cost Risk Analysis: The Risk Driver Approach Prioritizing Project Risks and Evaluating Risk Responses

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Outline (1)

- Some limitations of the traditional 3-point estimate quantitative risk analysis
- Introducing cost risk analysis using the Risk Driver Method
 - Method
 - Simple example

Risk Prioritization – New approach

- More complete and powerful than the standard qualitative risk analysis using the Probability and Impact approach
- Compute the effect of individual risks on the cost, then sort risks by priority
- Risks are prioritized by probability and impact as they affect the cost model of the project
- Distinguish the priority caused by the risks' probability from their impact range

Limits of the Traditional 3-point Estimate Approach (1)

- Traditionally we estimated the risk of each line item by applying a 3-point estimate of possible costs and a probability distribution
- This approach does not use the results of the qualitative risk analysis very well
- We want to know which risks are important to guide risk responses. Instead we find out which line items are important. There is a difference

Limits of the Traditional 3-point Estimate Approach (2)

- What is the probability that the risk will occur? 3-point estimate is an impact only
- What is the correlation between activity costs? We will model it instead of estimate it from interviews
- Which risks (not line items) are most important? If a risk affects several line items it may be more important than it appears at first

Introducing the Risk Driver Method (1)

- Start with the Risk Register risks – the linkage to the qualitative risk analysis exercise is obvious and direct
- Characterize the risks by their probability and impact, not just impact range as distinct from just the 3-point estimate. These are the TWO dimensions of a risk

Risk Driver Methodology

- Identify risks to be included from Risk Register
- Quantify risks' probability and impact range
 - The impact is a factor
 - The line item costs will be multiplied by the factors
- Assign risks to cost line items
 - Risks can affect several line items
 - A cost line item can be affected by several risks
- Run Monte Carlo simulation for overall cost risk
- Prioritize risks (either impact or probability)

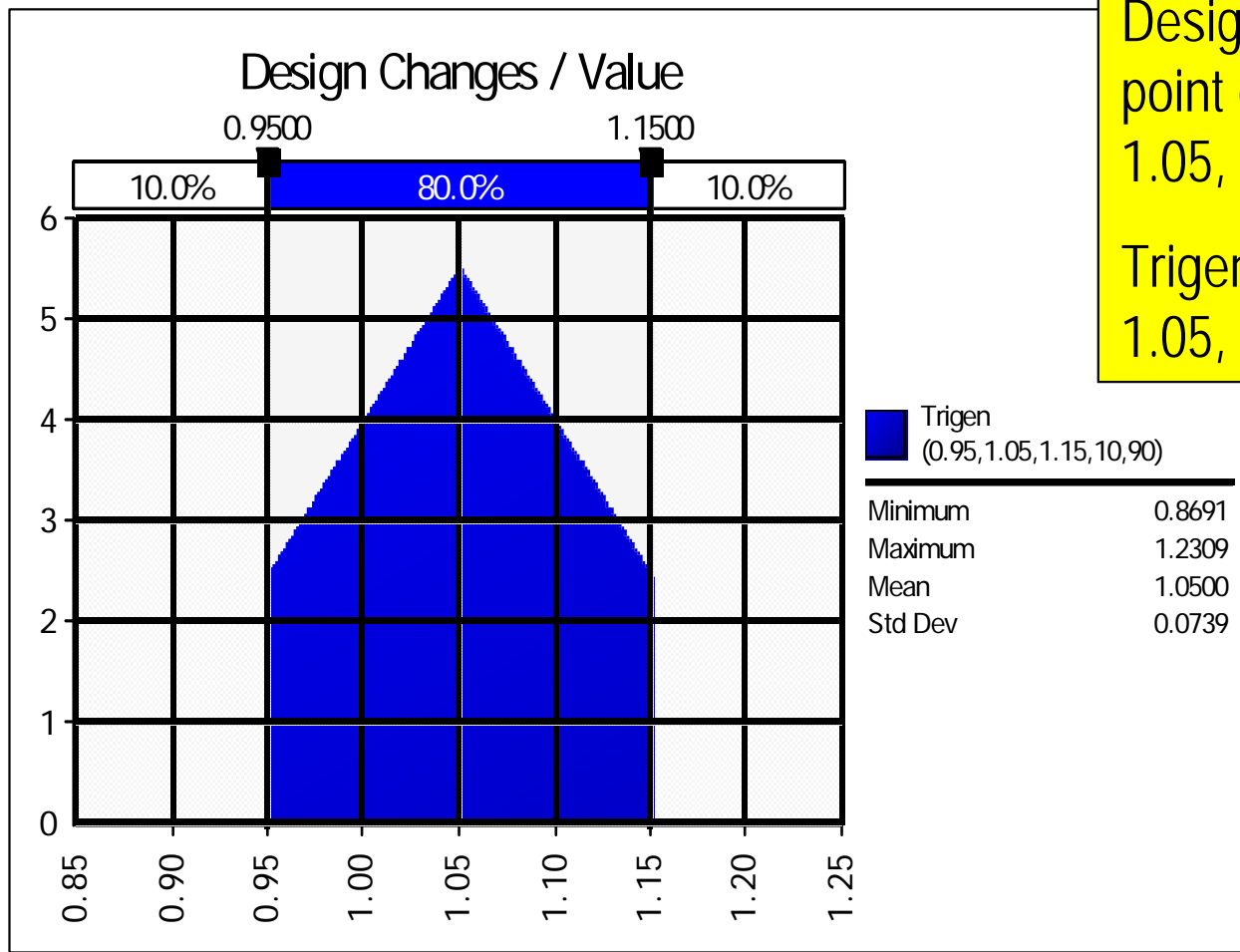
Identify Risk Drivers from the Risk Register

Risk Register - Model Input Data	
ID	Risk Name
R.1	Contracting Strategy (LSTK) may cause bidders to bid high
R.2	Design Changes may be greater than anticipated
R.3	Equipment Suppliers may be busy
R.4	Quality Key Staff JV / PMT may not be available
R.5	Number of Bidders may be limited due to availability of other work
R.6	Integration Management of detailed engineering may be inadequate
R.7	Labor Rate may differ from expectations
R.8	Construction Labor Productivity may differ from expectations
R.9	Bulk Material Cost may differ from expectations
R.10	Construction Management Staff may be lacking in experience

Risk Drivers and their Probability and Impact Range, Expressed as Factors

Risk Drivers and their Properties				
Name	Prob.	3-Point Estimate of Risk Factor		
		Minimum	ML	Maximum
Contracting Strategy	80%	0.90	1.10	1.30
Design Changes	100%	0.95	1.05	1.15
Equipment Suppliers Busy	30%	1.00	1.05	1.10
Availability of Key Staff JV / PMT	60%	0.85	1.00	1.20
Number of Bidders	30%	0.95	1.00	1.10
Integration Management	40%	1.00	1.05	1.10
Labor Rate	25%	0.80	0.95	1.05
Construction Labor Productivity	45%	1.00	1.10	1.20
Bulk Material Cost	100%	0.90	1.00	1.05
Construction Management Staff	100%	1.00	1.05	1.10

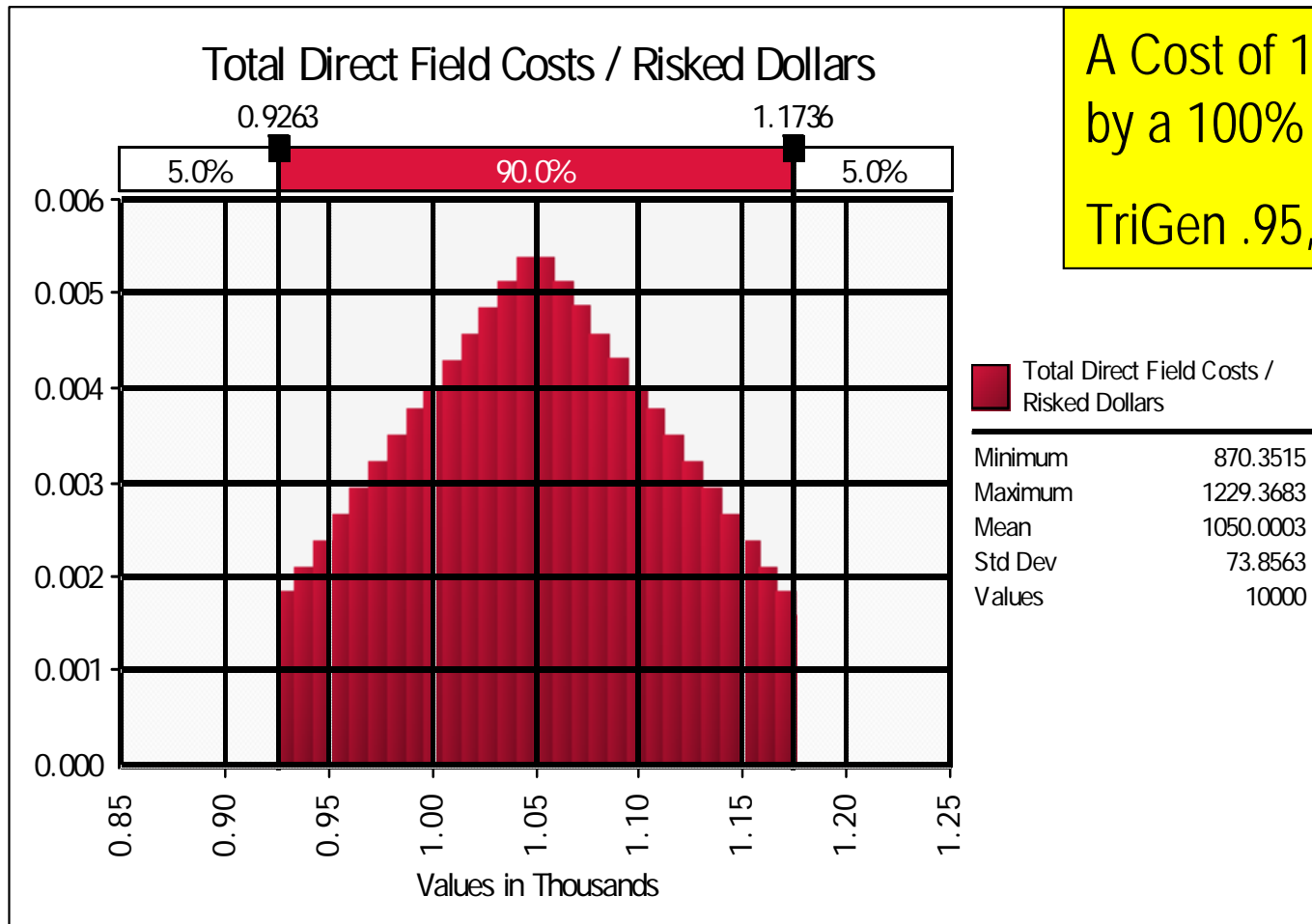
Use Trigen Function to Correct for Narrow Ranges from Interviews



Design Changes 3-point estimate is .95, 1.05, 1.15

Trigen makes it .87, 1.05, 1.23

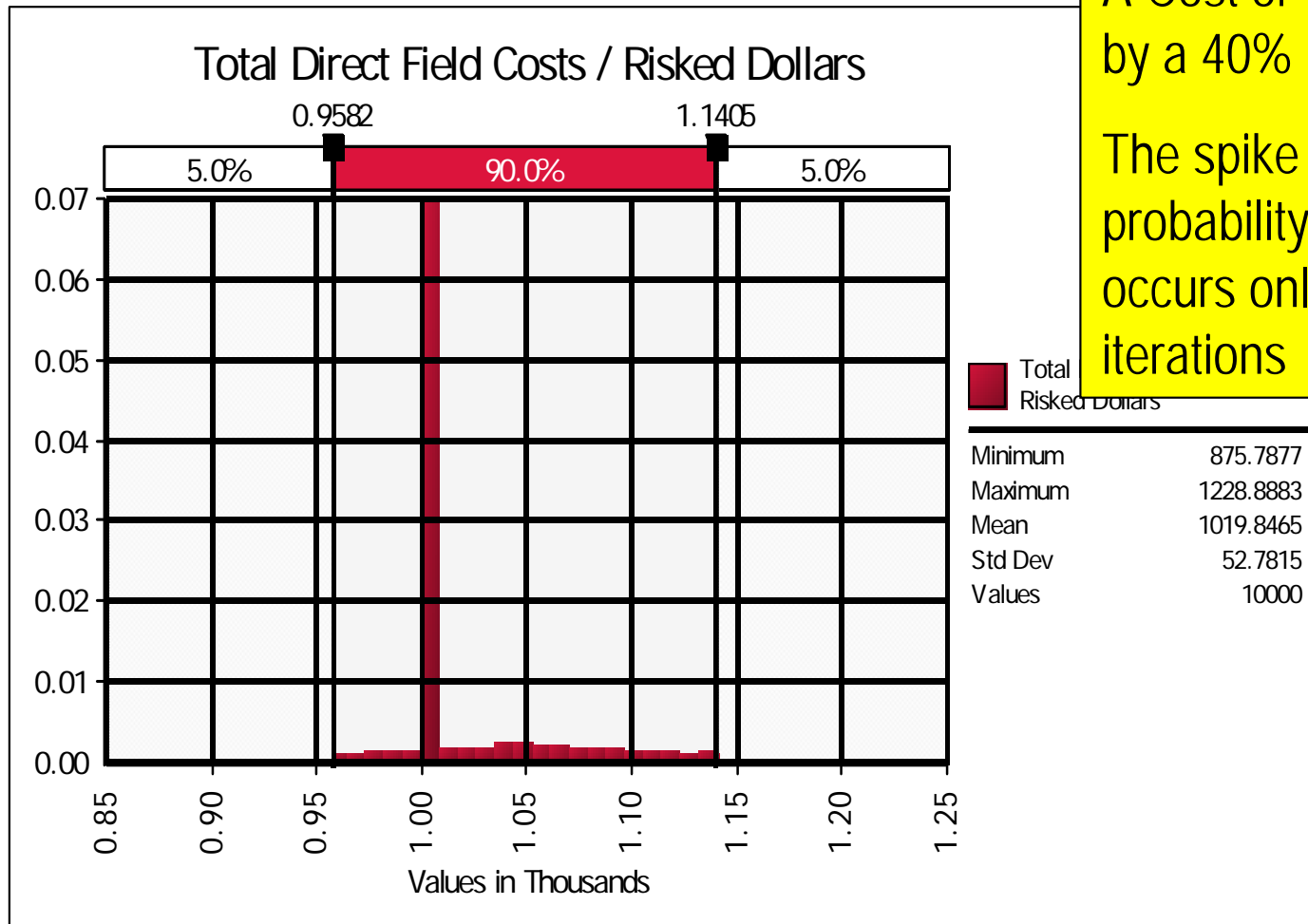
A 100% Risk Factor Applied to Cost



A Cost of 1.00 million impacted by a 100% Risk Factor

TriGen .95, 1.05, 1.15, 10, 90

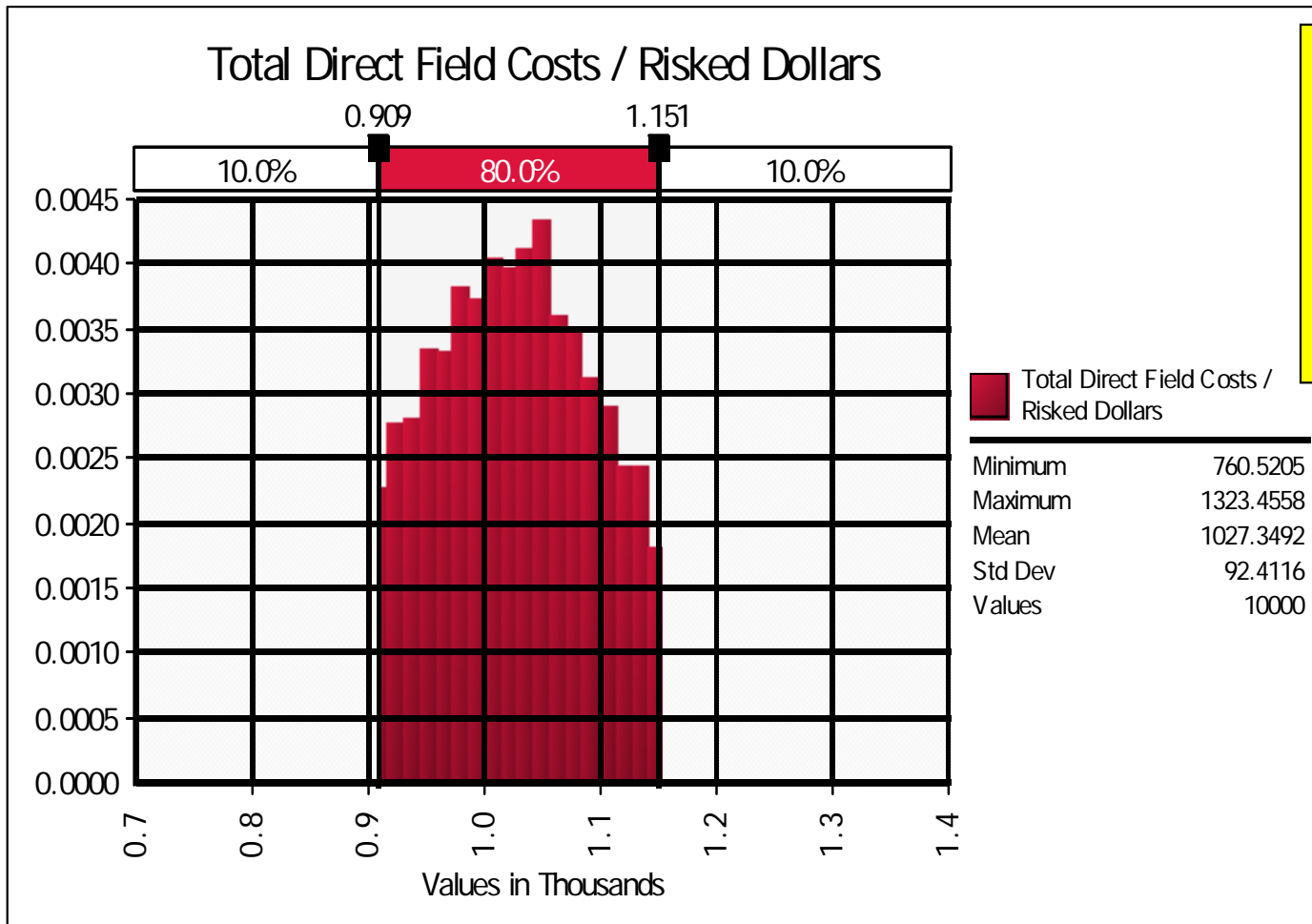
A 40% Risk Factor Applied to Cost



A Cost of 1.00 million impacted by a 40% Risk Factor

The spike has 60% of the probability, indicating that the risk occurs only in 40% of the iterations

A Cost of \$1.0 million Affected by Two 100% Risk Drivers

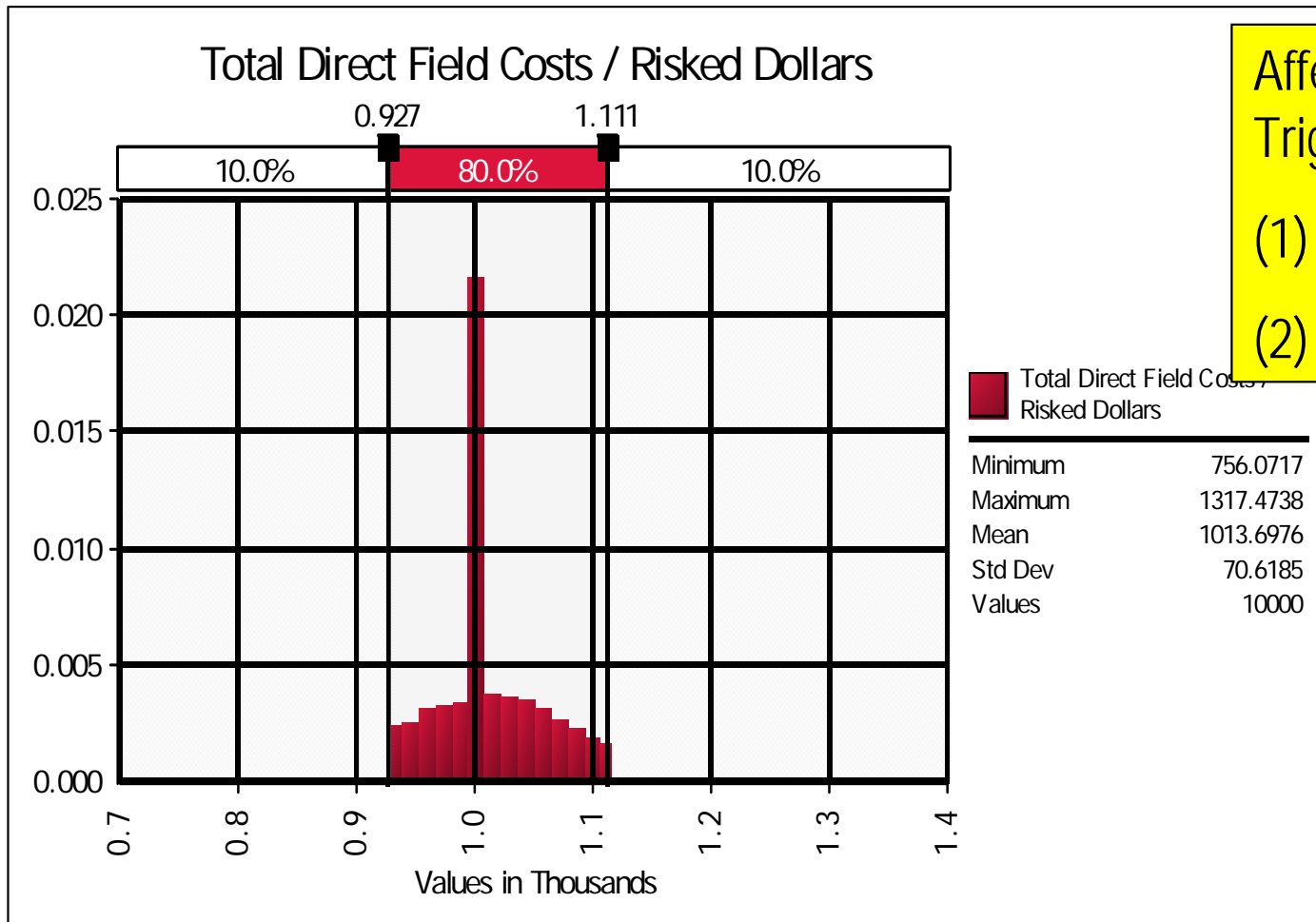


Affected by Two 100%
Trigen (10,90) Risks

(1) .95, 1.05, 1.15

(2) .90, 1.00, 1.05

A Cost of \$1.0 million Affected by Two 50% Risk Drivers



Affected by Two 50%
Trigen (10,90) Risks

(1) .95, 1.05, 1.15

(2) .90, 1.00, 1.05

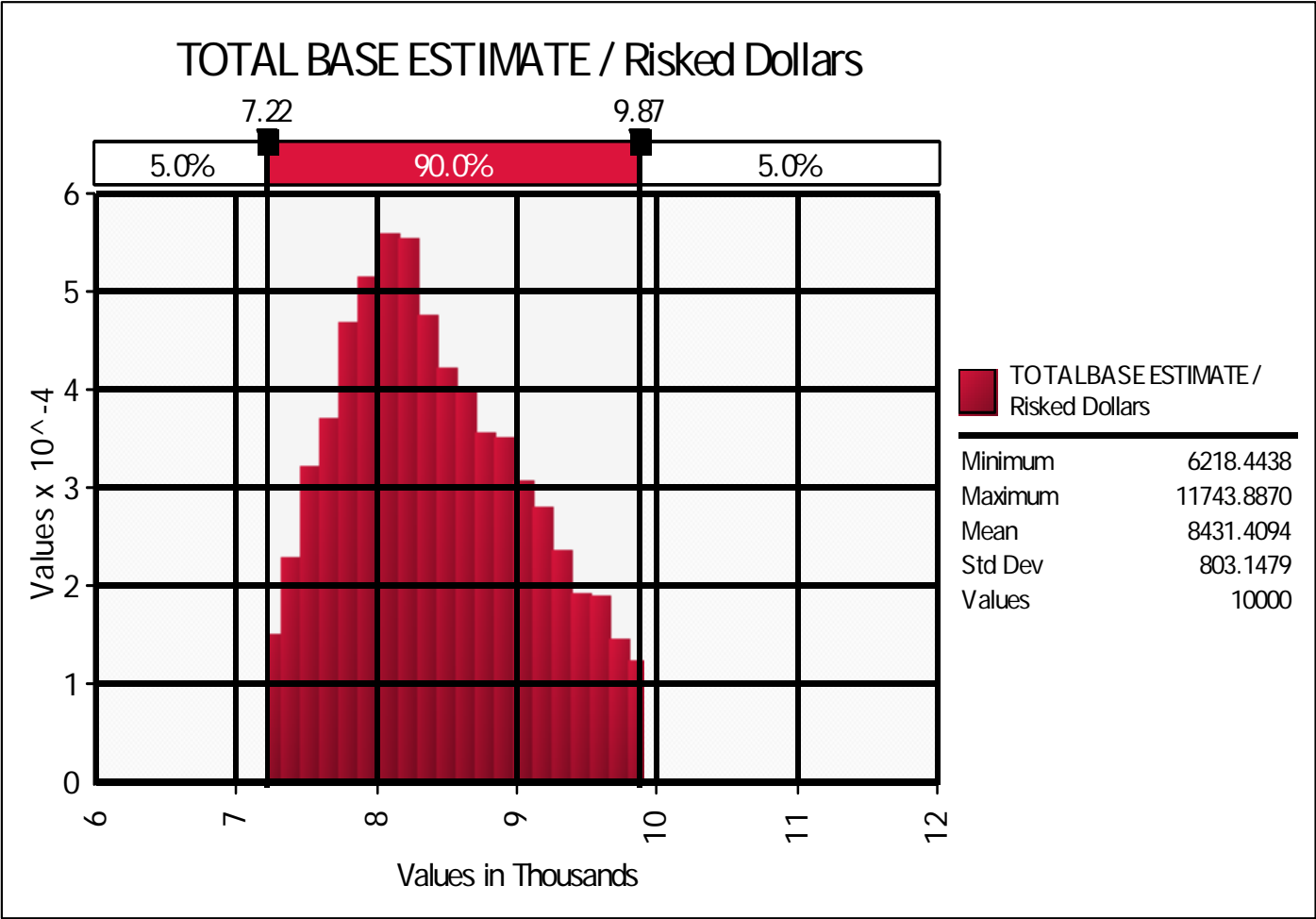
Simplified Cost Model of a Refinery Project (1)

Refinery Construction Project Baseline Estimate (1)				
	Cost Category	Labor	Equipment	Total
Direct Field Costs		(\$ millions)		
	Long Lead Equipment (LLE)	15	330	345
	Equipment	30	1,513	1,543
	Materials	288	2,248	2,536
	Total Direct Field Costs	333	4,091	4,424
Indirect Field Costs				
	Supervision	360	0	360
	Time-Related Overhead	315	0	315
	Total Indirect Field Costs	675	0	675
Total Direct & Indirect Costs		1,008	4,091	5,099

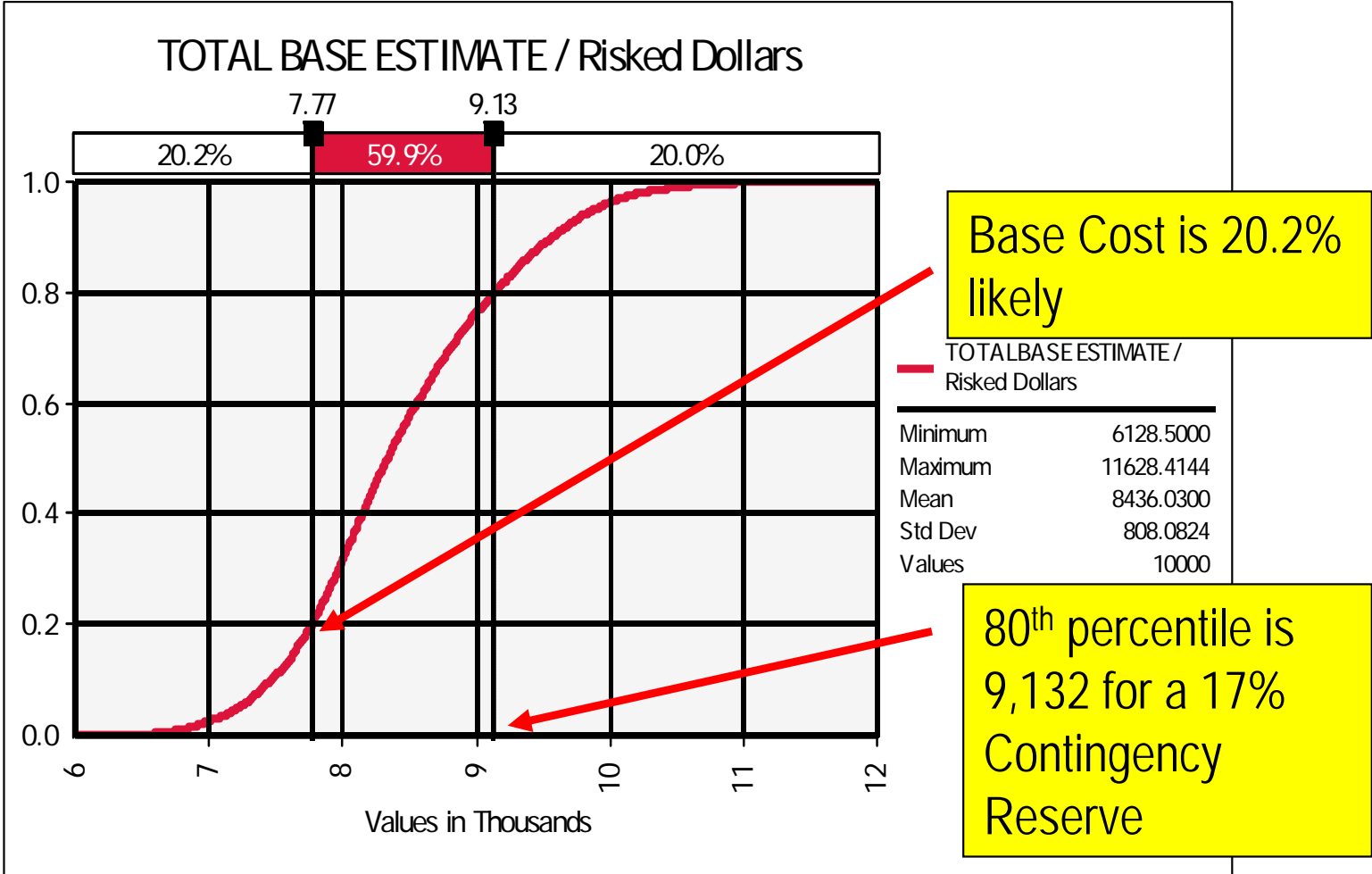
Simplified Cost Model of a Refinery Project (2)

Refinery Construction Project Baseline Estimate (2)				
		Labor	Equipment	Total
	Cost Category	(\$ millions)		
	Material Related	180	540	720
	Home Office Engineering Staff	540		540
	Overhead & Fees			560
Total Contractor Related		1,728	4,631	6,919
Owner-Related				
	Project Management Team	450	0	450
	Materials	0	400	400
	Total Owner-Related	450	400	850
TOTAL BASE ESTIMATE				7,769

Cost Risk Analysis Results (1)



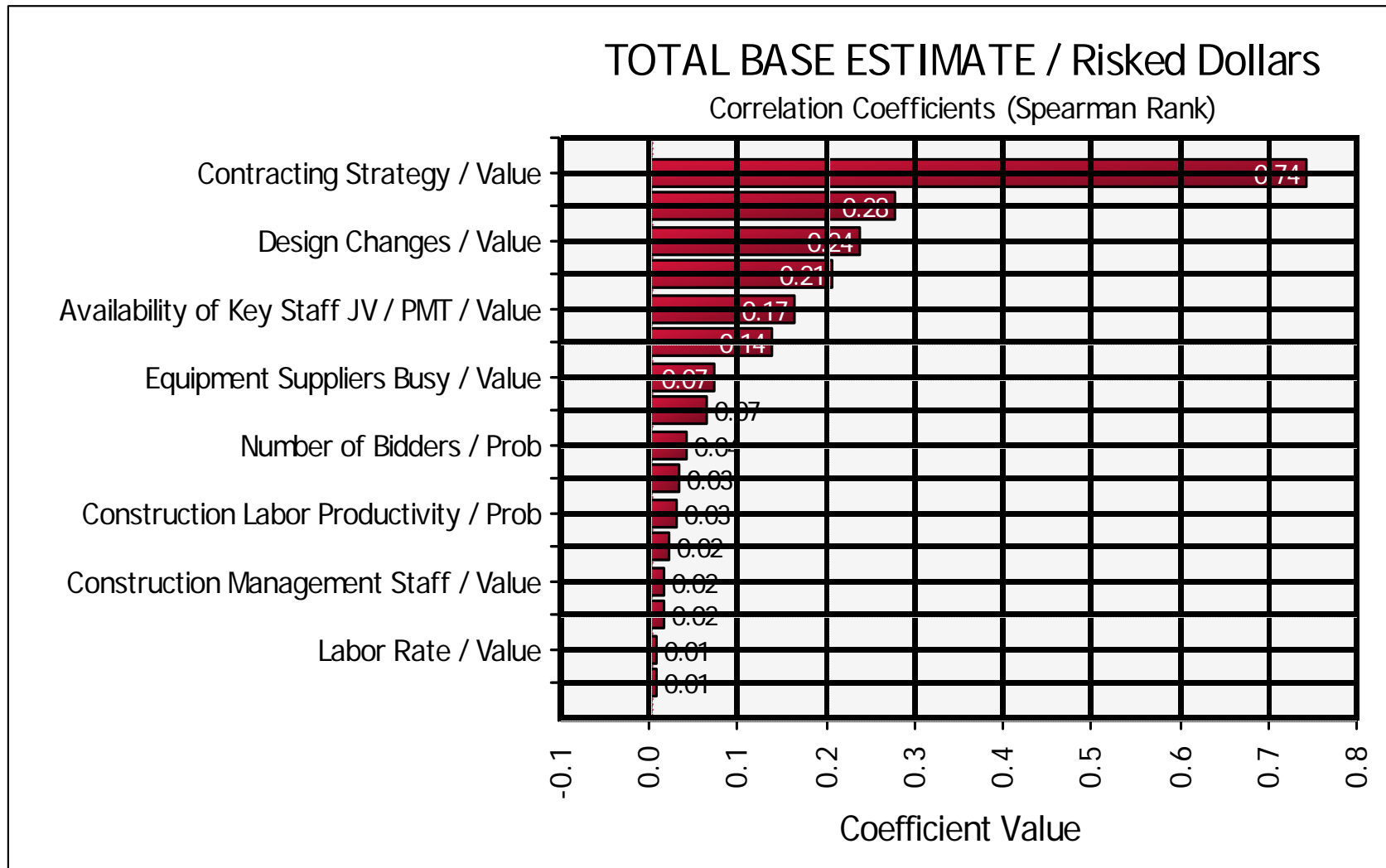
Cost Risk Analysis Results (2)



Cost Risk Analysis Results (3)

Percentile	Cost	% Contingency
10%	7,469	-4%
20%	7,769	0%
30%	7,967	2%
40%	8,150	5%
50%	8,336	7%
60%	8,556	10%
70%	8,810	13%
80%	9,132	17%
90%	9,566	23%

Risk Sensitivity



Risk Drivers Listed in Priority Order

Risk Drivers Effect on the Contingency to 80th Percentile			
All-In Risks	9,132		
	Improvement if Mitigated		Type of Risk
Risk Name	Dollar	%	
Contracting Strategy	820	9.0%	Threat
Design Changes	169	1.9%	Threat
Equipment Suppliers Busy	88	1.0%	Threat
Number of Bidders	48	0.5%	Threat
Construction Management Staff	44	0.5%	Threat
Availability of Key Staff JV / PMT	36	0.4%	Threat
Construction Labor Productivity	32	0.4%	Threat
Integration Management	24	0.3%	Threat
Labor Rate	-4	0.0%	Opportunity
Bulk Material Cost	-57	-0.6%	Opportunity

Risk Mitigation (1)

- The Contracting Strategy of Lump-Sum-Turnkey (LSTK) is by far the most important cost risk driver in today's heated oil and gas industry environment
- Contractors are expected to include high levels of risk and profit into their bids

Risk Mitigation (2)

- Suppose that we were willing to entertain cost-based bids.
What would happen?

Mitigating the Contracting Strategy Risk				
Name	Prob.	3-Point Estimate of Risk Factor		
		Minimum	ML	Maximum
Contracting Strategy Before Mitigation	80%	0.90	1.10	1.30
Contracting Strategy After Mitigation	30%	0.90	1.00	1.10

Effect of Allowing Cost-Based Bids

Percentile	Before Mitigation	After Mitigation
10%	7,469	7,518
20%	7,769	7,685
30%	7,967	7,804
40%	8,150	7,909
50%	8,336	8,006
60%	8,556	8,103
70%	8,810	8,210
80%	9,132	8,339
90%	9,566	8,534

The Cost-Based contracts may provide less certainty for the owner.

However, in today's heated environment the LSTK premium bid by contractors may be so large that owners' accepting the extra uncertainty could pay off, as in this example

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