

Applying Probabilistic Methods to Quantify Uncertainties in the Request for Proposal (RFP) Process

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November 13, 2008



Imagine the result

Topics

- Request for Proposal (RFP) Process and the need for Probabilistic Methods (Risk Analysis)
 - What is the RPF process?
 - Issues
 - Why Apply Probabilistic Methods?
- Risk Analysis
- Example Case Studies and Results

The Request for Proposal Process

- A RFP process is “an invitation for suppliers, often through a bidding process, to submit a proposal on a specific commodity or service. A bidding process is one of the best methods for leveraging a company's negotiating ability and purchasing power with suppliers. The Request process brings structure to the procurement decision and allows the risks and benefits to be identified clearly upfront” (*Wikipedia*)
- Agencies and companies using the RFP process (especially large capital projects) are increasingly encountering situations where:
 - Bids received are drastically different from internal estimates
 - Durations of projects exceed proposed timeframes

Typical Request for Proposal Process

- Many agencies and companies apply the RFP process for large capital projects
- Examples of information provided to potential bidders include:
 - Drawing/specifications
 - Timeframes
 - Quantity of materials or repairs needed
 - Example Phasing Plans
 - Terms, Conditions and Restrictions
- Bidders respond (to these complex and detailed information) within a specified timeframe with a proposal that includes a cost estimate and a proposed schedule

Evaluation and Selection Phase

- After proposal(s) are received, the agency or company evaluates the different proposals
- Typically, proposals are selected by comparing:
 - Bidder cost (lump sum) to an internal cost estimate
 - Bidder schedule to an internal schedule
 - Specific expertise provided by a bidder
- Cost and schedule evaluation are confined to a point estimate (for a particular project element)
 - Quantity of materials
 - Labor hours
 - Duration of activities, etc....



Issues and Challenges

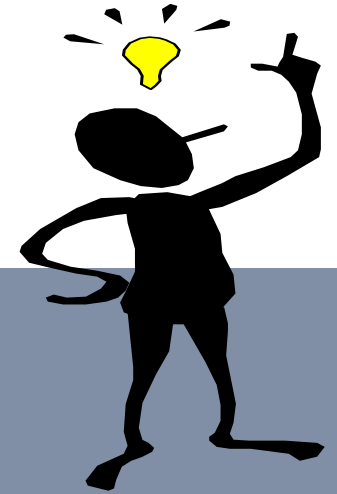
- Agency/Company and bidders apply different assumptions concerning different elements of the RFP (with the exception specified deadlines)
 - Cost estimates can include thousands of line items
 - Schedule estimates can contain hundred of activities
 - All these elements are uncertain but the cost/schedule estimates are compared to point estimates
- Typically, the result is:
 - Bidders' estimates fall outside of the “acceptable” internal estimate
 - Projects take longer than anticipated inducing payment of liquidated damages and additional expenditures

Additional Issues to Address

- Both parties need to also consider:
 - Long timeframe
 - Multiple sub-contractors and specialty skills may be required
 - Contractor competition, availability and bonding
 - Specialty equipment
 - Fabrication and procurement of materials
 - User approvals
 - Staging areas
 - Permitting and restrictions
 - Liquidated damages
 - Etc...



A Solution



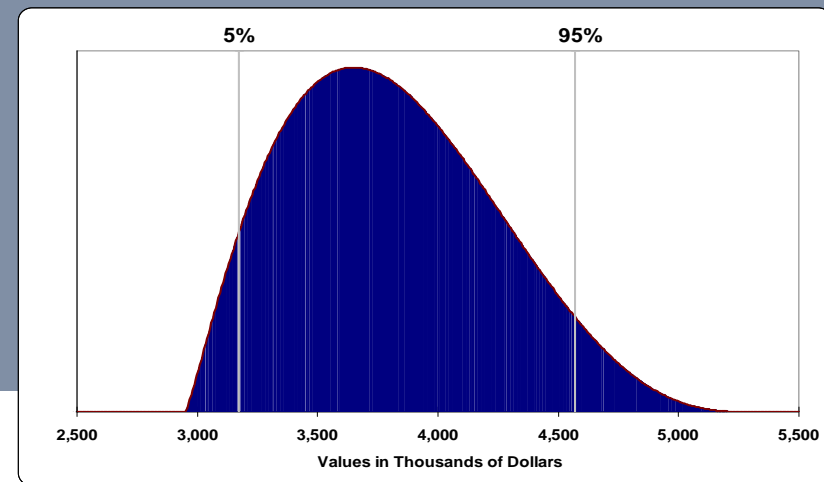
- Use probabilistic methods and tools (e.g., @RISK, PrecisionTree) to navigate the RFP process
 - Provides useful information to the internal team
 - Helps with understanding uncertainties (and relationships) in the various cost and schedule elements
 - Helps quantify the potential ranges
- ARCADIS helps our clients through the use of a probabilistic framework to evaluate internal cost and schedule estimates to determine a reasonable range of estimates and expected project durations before a project is put out for bid

Some Benefits of Applying Probabilistic Methods

- More is better !
 - Better information
 - Better understanding of risks and uncertainties
 - Better informed stakeholders
 - A range is better than a point estimate
- Cost and Schedule Mitigation Opportunities
 - Identification of key drivers and opportunities to mitigate or risk manage/self-insure

Our Risk Analysis Approach...

- ▶ Initial cost and schedule review with stakeholders
- ▶ Conduct an overview presentation of probabilistic tools and risk analysis
- ▶ Conduct workshops with subject matter experts
- ▶ “Rebuild/expand” internal cost and schedule estimates and incorporate identified risks and uncertainties
- ▶ Generate and present results



Example Risk Analysis Projects and Results

Example RFP Projects

- Tunnel projects
- Subway station rehabilitation
- Decommissioning and Demolition projects
- Power plant construction
- Transmission line construction

Risk Analysis

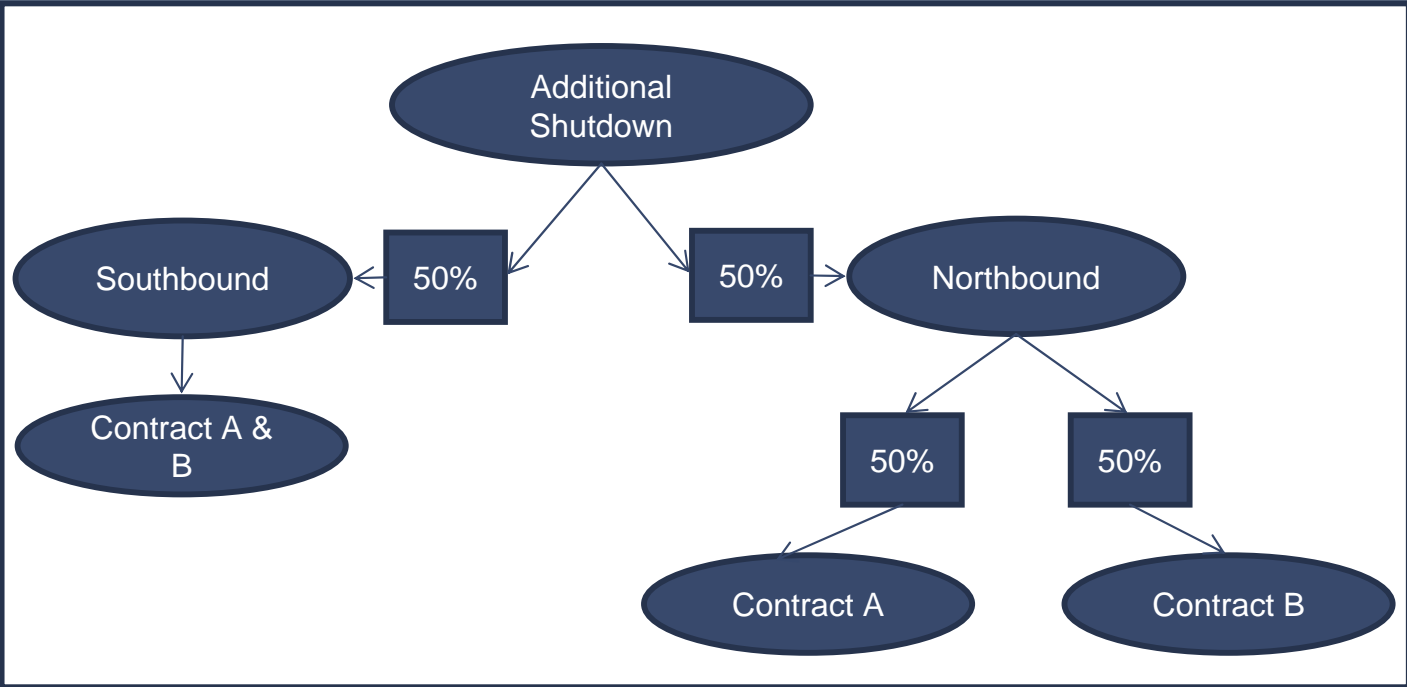
- ARCADIS incorporates risk and uncertainty into both cost and schedule estimates to generate reasonable ranges around internal cost and schedule estimates
 - Evaluates risk from a bidder's point of view
 - Risk Events: typically an event with a small probability but a large impact on the project if it were to occur
 - Uncertainties: ranges around point estimates used in estimation

Cost and Schedule Modeling

- Create one integrated cost and schedule model using the @RISK add-on in Excel
 - Example distributions used are typically pert (BPJ) and discrete
 - Captures various relationships in the modeling exercise
- Create correlations between project elements and between cost and schedule
- Incorporate different work schedules into model using look-up tables
- Incorporate ‘switches’ that allow evaluation of sensitivity to a risk or uncertainty that impacts multiple project elements

Itemized Risk List and Relationships

40		40	Allowance for Lost Time due to Other Contractor Fault	Bid Increase	100%		\$500,000	\$750,000	\$1,000,000	Perf
40	C:8A		Contract A - Allowance for Lost Time			\$0	\$500,000	\$750,000	\$1,000,000	
40	C:8B		Contract B - Allowance for Lost Time			\$0	\$500,000	\$750,000	\$1,000,000	
41		41	Bonding Agent Change	Bid Increase	100%		2%	2%	2.25%	Perf
41	C:8A		Contract A - Bonding and Insurance			\$1,569,244	\$1,569,244	\$1,569,244	\$1,759,863	
41	C:8B		Contract B - Bonding and Insurance			\$1,306,483	\$1,306,483	\$1,306,483	\$1,469,793	
42		42	Lack of General Contractor Competition	Bid Increase	100%		15%		20%	Discrete
42	C:8A		Contract A - Profit		10%	\$10,202,107			\$13,602,810	
42	C:8A		Contract A - Profit		90%	\$10,202,107	\$10,202,107			
42	C:8B		Contract B - Profit		10%	\$8,520,540			\$11,360,719	
42	C:8B		Contract B - Profit		90%	\$8,520,540	\$8,520,540			



Scheduling

103	22	S.L.D.F.,	1452.FS	0.	2.	74,*100B	.SS	44.	132.	0					
		22 1	0	MOB1	Prep Work for DOT (Netting, Barricade etc)					18EP09	30SEP09	18EP09	30SEP09	0	
		P.L.D.F.,	100.FS	0.	66.	0,	100.FF	0.	66.	0					
		P.L.D.F.,*	101.FF	0.	131.	0,									
		S.L.D.F.,*	204.FS	0.	87.	0,									
104	218	218 1	0	GO	General Order - S/B					10CT09	2AUG10	20CT09	3AUG10	1	
		P.L.D.F.,*	101.FS	0.	131.	0,									
		S.L.D.F.,	231.FF	0.	132.	0,	308.SS	0.	2.	70					
		S.L.D.F.,*	690.FS	0.	2.	10,*376B	.FS	0.	2.	72					
		S.L.D.F., 548B	.SS	0.	2.	154,									
106	194	194 1	0	GO	General Order - N/B					6AUG10	4MAY11	3NOV10	1AUG11	63	
		P.L.D.F.,*	100.FS	286.	66.	0,	706.FF	0.	2.	86					
		P.L.D.F.,	958.FF	0.	2.	79,	1060.FF	0.	2.	79					
		P.L.D.F.,	1158.FF	0.	2.	76,	1258.FF	0.	2.	76					
		P.L.D.F.,	1358.FF	0.	2.	74,	1458.FF	0.	2.	74					
		P.L.D.F., 198B	.FF	0.	2.	72, 258B	.FF	0.	2.	80					
		P.L.D.F., 376B	.FF	0.	2.	72, 430B	.FF	0.	2.	94					
		P.L.D.F., 478B	.FF	0.	2.	94,									
		S.L.D.F.,	1500.FS	0.	64.	0, 600B	.FS	0.	65.	0					
204	87	87 1	0	STAT1	Stage 1: West Mezz Floor & Roof Extensions / EMR					10CT09	29JAN10	10CT09	29JAN10	0	
		P.L.D.F.,	100.FS	0.	66.	0,*	101.FS	0.	131.	0					
		P.L.D.F.,*	103.FS	0.	22.	0,									

					Stat1 - Stage 1: Stair S4 / M4	10/01/09	12/01/09	43	44		36		43	10/01/09	12/01/09		
					Stat1 - Stage 1: West Mezz Floor & Roof Extensions / EMR	10/01/09											
206	44	44 1	0	*	204	SS	0										
		P.L.D.F.,*	208					10/19/09	10/20/09	465	2	1	1	1	1	10/19/09	10/20/09
		S.L.D.F.,*															
208	2	2 1	0	*	308	SS	0										
		P.L.D.F.,*						10/15/09	10/19/09								
		S.L.D.F.,	210					10/19/09	06/21/10	269	176	99	175	175	175	10/19/09	06/21/10
		S.L.D.F.,*						10/15/09	10/19/09					175			
		P.L.D.F.,*	212					06/22/10	07/21/10	269	22	21	29	39	21	06/22/10	07/21/10
		S.L.D.F.,*						06/22/10									
		P.L.D.F.,*	213					04/01/11	06/01/11	0	44		36		43	04/01/11	06/01/11
		S.L.D.F.,*							04/01/11								
		P.L.D.F.,*	214					10/22/09	11/02/09	64	8		8		7	10/22/09	11/02/09
		S.L.D.F.,															
		P.L.D.F.,*						10/01/09	10/22/09								
		S.L.D.F.,	204														
		P.L.D.F.,						01/29/10	11/02/09				10/22/09				

Correlations and Look-ups

Correlates GC Green Cells

GC_Greens (27x27)	GC!L11 MO / Dist.	GC!L12 MO / Dist.	GC!L13 MO / Dist.
GC!L11 MO / Dist.	1.00		
GC!L12 MO / Dist.	1.00	1.00	
GC!L13 MO / Dist.	1.00	1.00	1.00
GC!L14 MO / Dist.	1.00	1.00	1.00
GC!L15 MO / Dist.	1.00		

0	84	3/1/2011	0	2	3/1/2011	0	0	3/1/2011
0	84	3/2/2011	0	2	3/2/2011	0	0	3/2/2011
0	84	3/3/2011	0	2	3/3/2011	0	0	3/3/2011
0	84	3/4/2011	0	2	3/4/2011	0	0	3/4/2011
1	85	3/5/2011	1	3	3/5/2011	0	0	3/5/2011
1	86	3/6/2011	1	4	3/6/2011	0	0	3/6/2011
0	86	3/7/2011	0	4	3/7/2011	0	0	3/7/2011
0	86	3/8/2011	0	4	3/8/2011	0	0	3/8/2011
0	86	3/9/2011	0	4	3/9/2011	0	0	3/9/2011
0	86	3/10/2011	0	4	3/10/2011	0	0	3/10/2011
0	86	3/11/2011	0	4	3/11/2011	0	0	3/11/2011
1	87	3/12/2011	1	5	3/12/2011	0	0	3/12/2011
1	88	3/13/2011	1	6	3/13/2011	0	0	3/13/2011

Switch Items

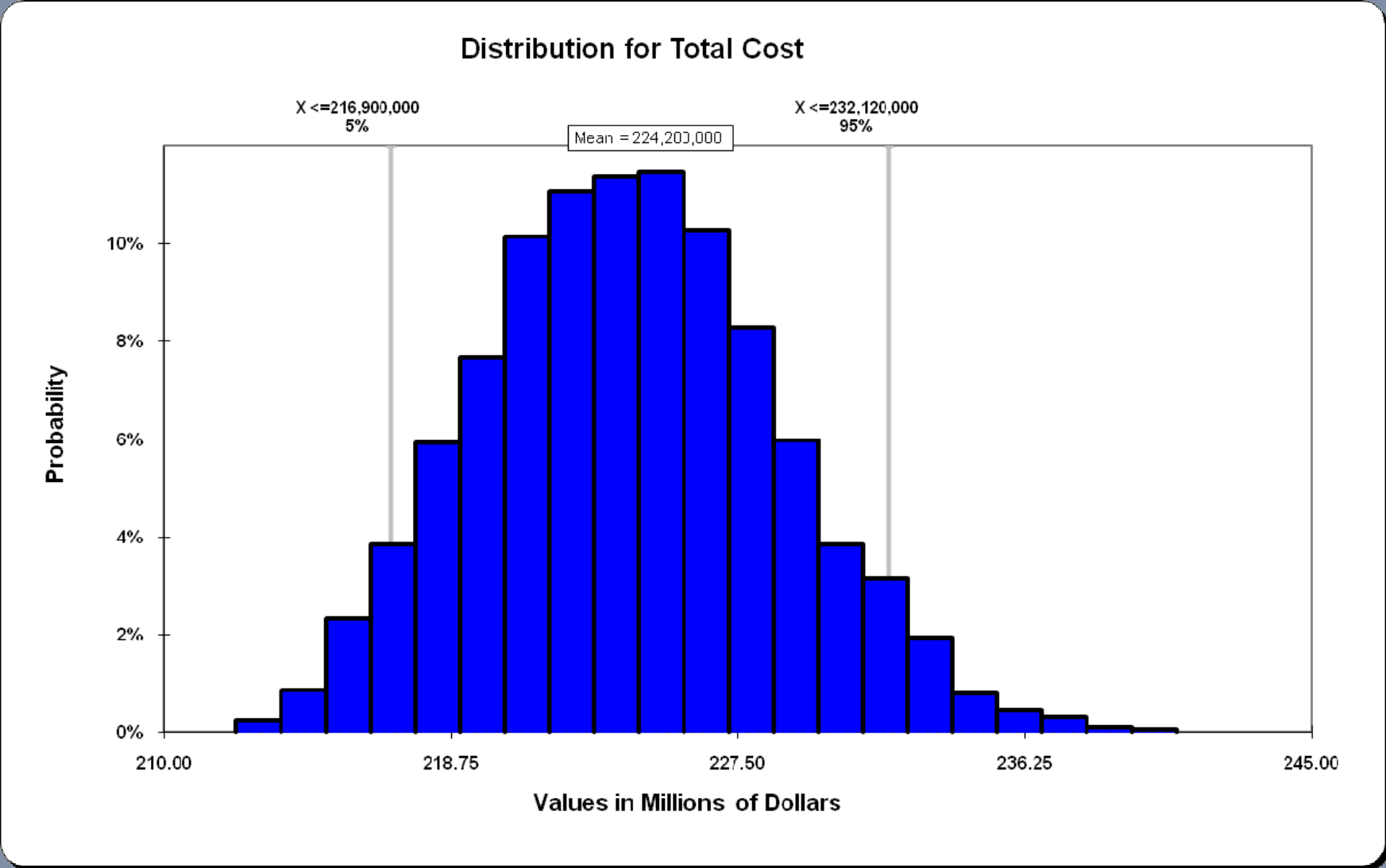
6	Need for Additional Equipment				1On / Off
7	Material Cost Fluctuations for Metal, Concrete, and Track Material (excluding structural steel and signal & electric equipment)				1On / Off
8	Material Cost Fluctuations for other Materials (excluding metal, concrete, track material, structural steel)				1On / Off
9,10,11,12	Variance extras				1On / Off
13	AFI				1On / Off
14	Total Cost of Signal Work				1On / Off
16,17,18	GC - Wages				1On / Off

15,19,20,21,22, 23, 24, 25, 26, 27, 28,29	FE Cost Adjustments
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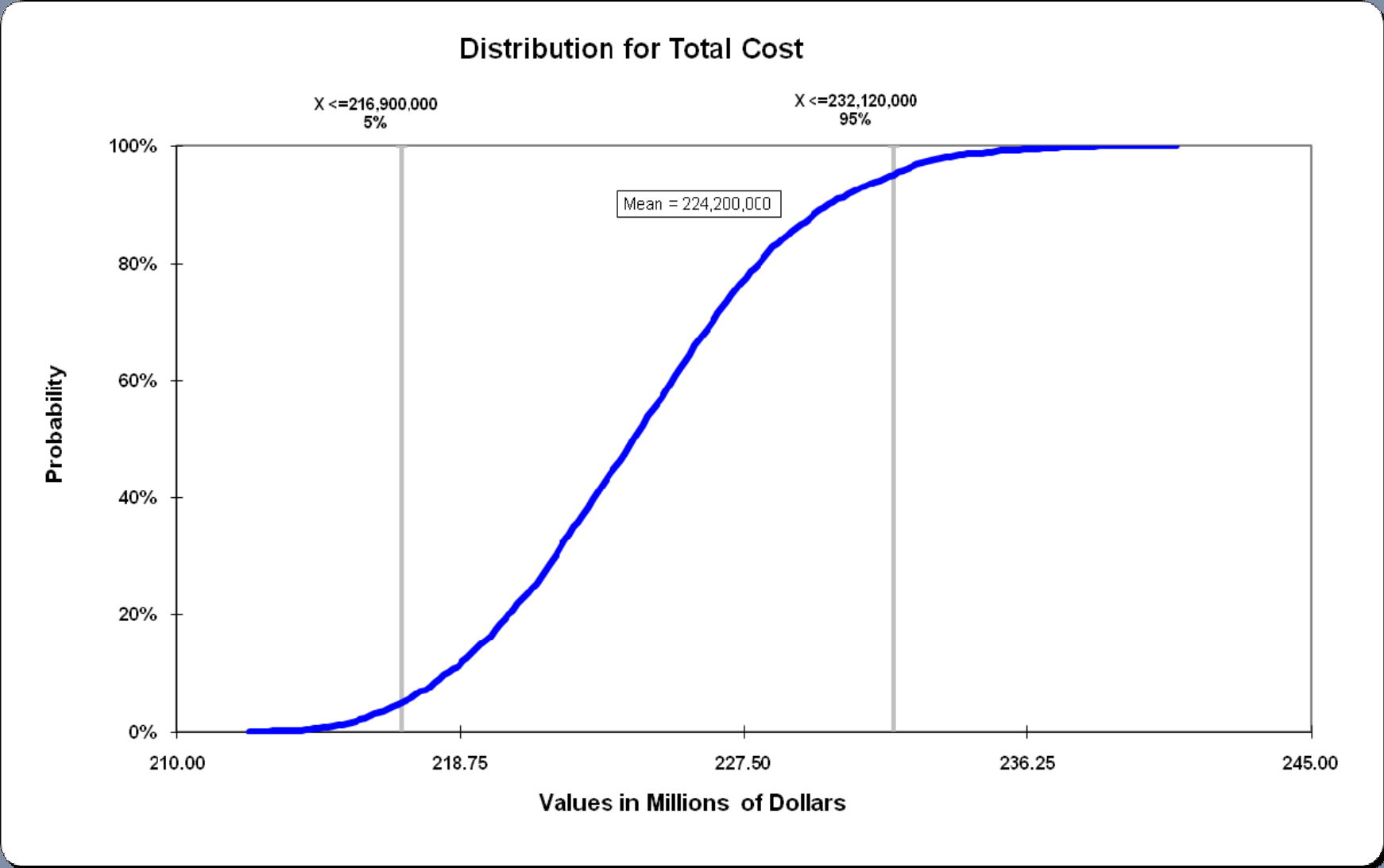
DRAINAGE			MAT'L & EQUIP COST					TOTAL
DESCRIPTION	QTY	UN	UNIT	BC	ML	WC	Dist.	TOTAL
DRAINAGE								
REMOVE EXISTING DRAINAGE PIPE	29	LOC						
DUMPSTER	4	EA	\$520				\$520	\$2,080
CLEAN EXISTING STEEL PIPE (29 LOC AVE 50LF/LOC)	29	LOC	\$100				\$100	\$2,900
F & I 4" DRAIN SHELL (JOSAM 21500-Z)	121	EA	\$450	\$473	\$473	\$482	\$474	\$57,354
4" FIBERGLASS Red Thread II PIPE	700	LF	\$8.50				\$9	\$5,950
6" FIBERGLASS Red Thread II PIPE	1,750	LF	\$14.65				\$15	\$25,638
8" FIBERGLASS Red Thread II PIPE	200	LF	\$22.00				\$22	\$4,400
CLEAN OUT AND PLUG	92	EA	\$160				\$160	\$14,720
Y CONNECTOR	121	EA	\$242	\$254	\$254	\$259	\$255	\$30,844
4" ELBOW	121	EA	\$70	\$74	\$74	\$75	\$74	\$8,922
8'X6" REDUCER	1	EA	\$318	\$334	\$334	\$340	\$335	\$335
6"X4" REDUCER	121	EA	\$201	\$211	\$211	\$215	\$212	\$25,618
HANGER & SUPPORT	170	EA	\$200	\$210	\$210	\$214	\$211	\$35,813

\$1.00

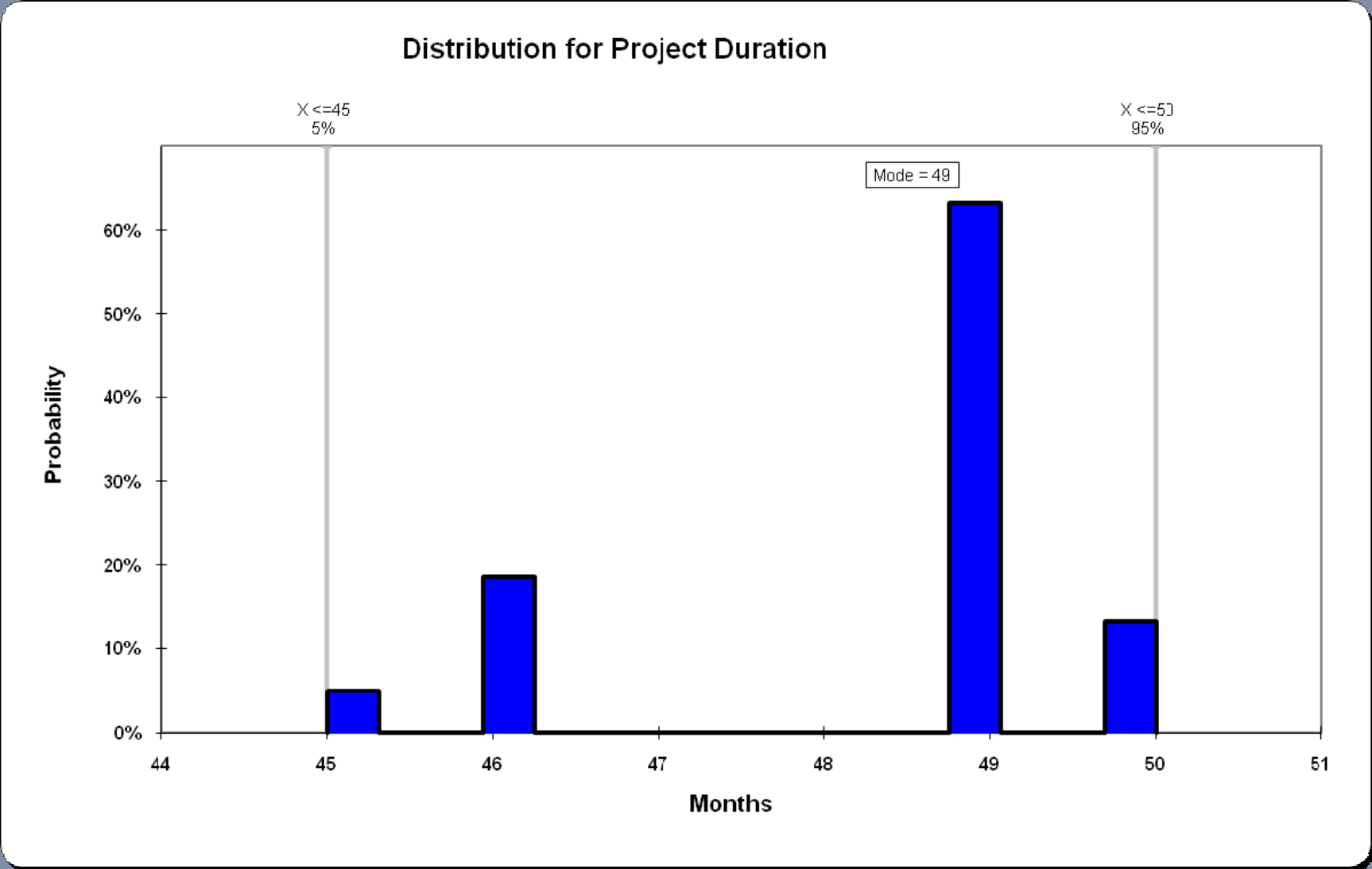
Bid Cost Results



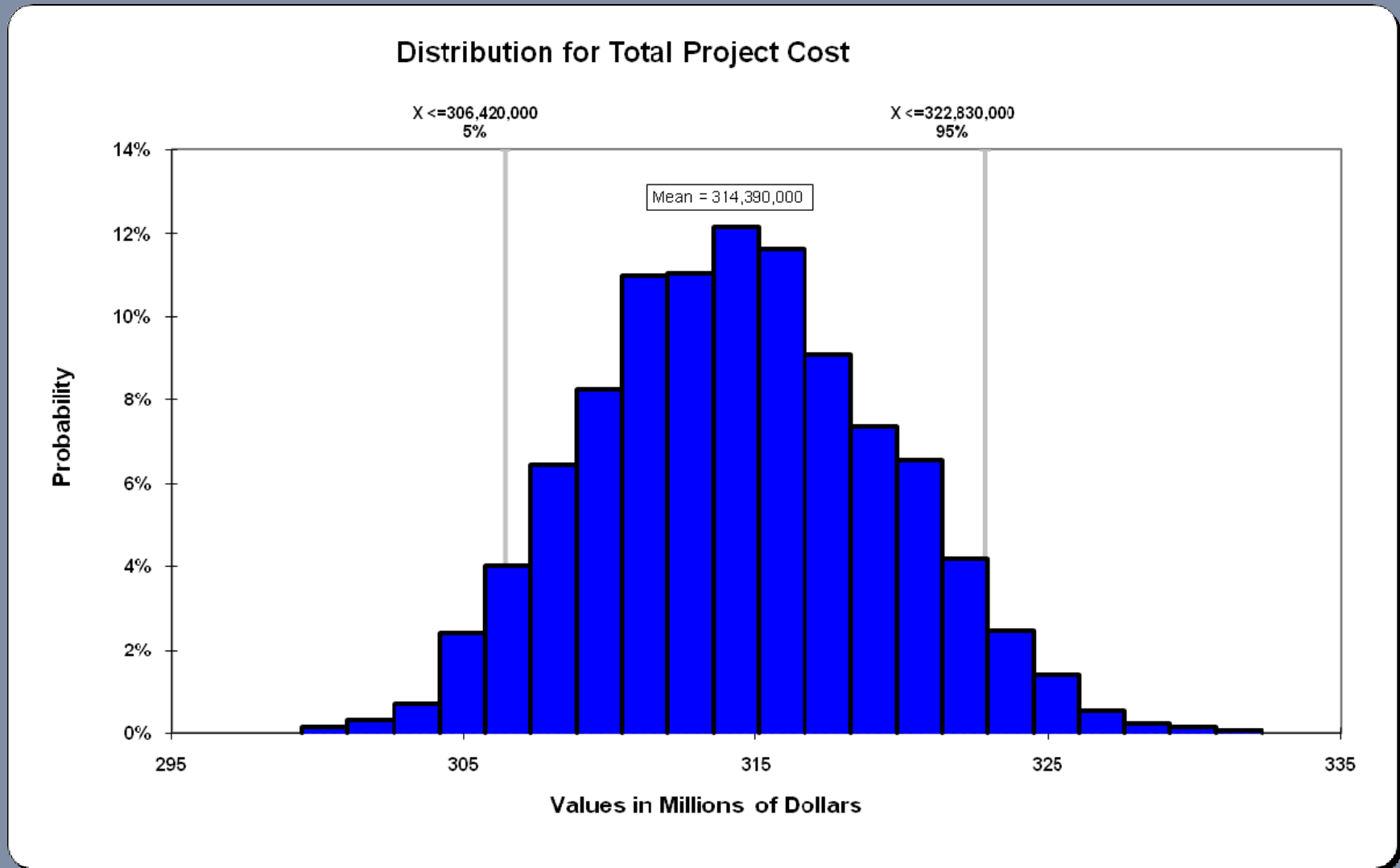
Bid Cost Results



Schedule Results



Total Project Cost



Benefits of a Probabilistic (Risk Analysis) Approach

- Agencies/companies can use a chosen “cut-off” point for evaluating various bid cost estimates
- Evaluating schedule even though the bidder is confined to a specified deadline
 - Incorporates schedule uncertainties into cost estimates which bidders presumably incorporate
 - Allow for evaluation of potential total cost to assist in internal budgeting for the project
- Stakeholders have more information and understanding of project uncertainties
- Gets all stakeholders on same page regarding the project and assists in identifying mitigations for project risk

Contact Information

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