Schedule and Cost Risk Simulation

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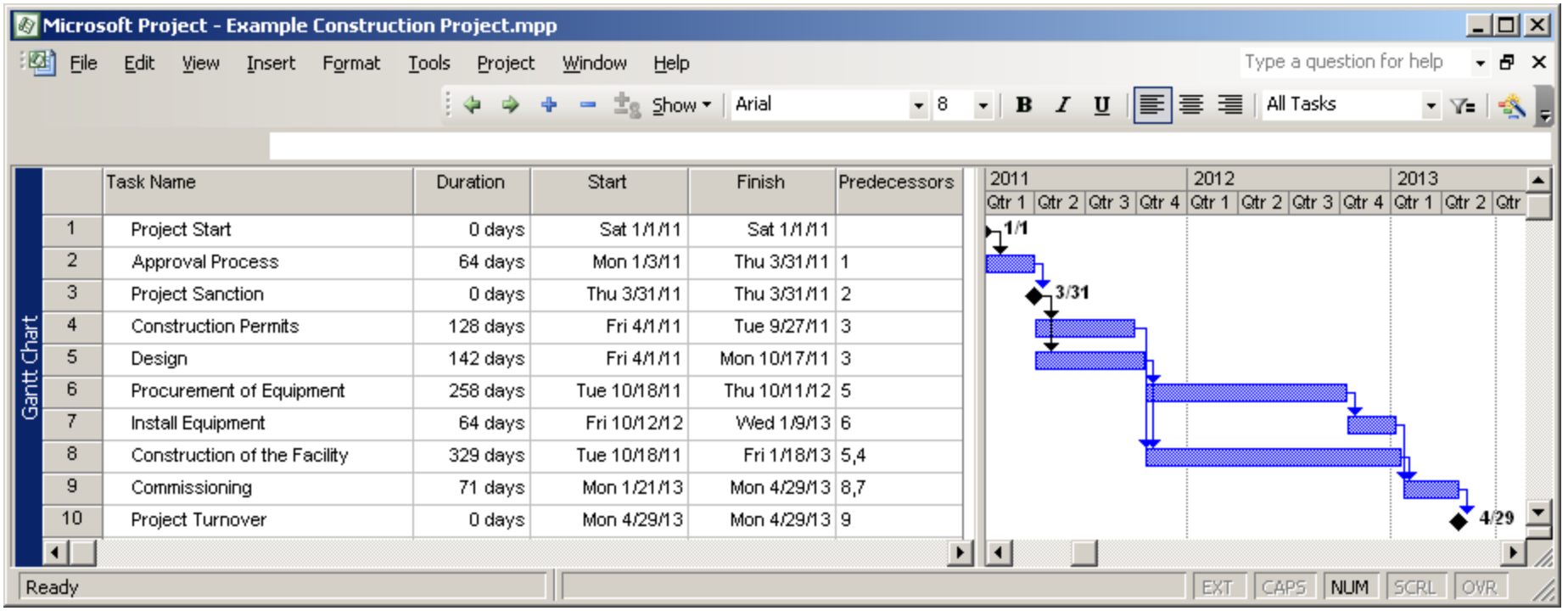
Agenda

- Introduction
- Basis of the Analysis
- Example of the use of Monte Carlo type simulation in cost and schedule risk analysis
- Discussion or Questions

Basis of the Analysis

- Association for the Advancement of Cost Engineering (AACE) Recommended Practice (No. 57R-09) for analyzing schedule and cost risk. (http://www.aacei.org/non/rps/57R-09.pdf)
- Guidelines for cost and schedule risk analysis
- Results used to determine:
  - Schedule contingency reserve
  - Cost contingency reserve
  - Joint probability distribution of cost and schedule
  - Prioritize risks leading to the need for reserves

MS Project Schedule

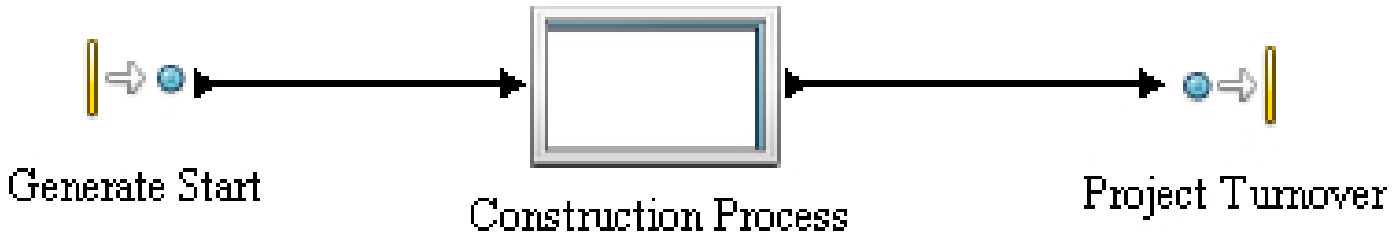


- Schedule and Cost is initially estimated WITHOUT contingency reserves
- Cost is driven mostly by the resources assigned to the schedule
- High-level or roll up of the schedule is best for this purpose but can certainly support the detail – its just a lot more work to get to the same result
- Qualitative risk data is determined as it normally would and is used as input to the simulation model

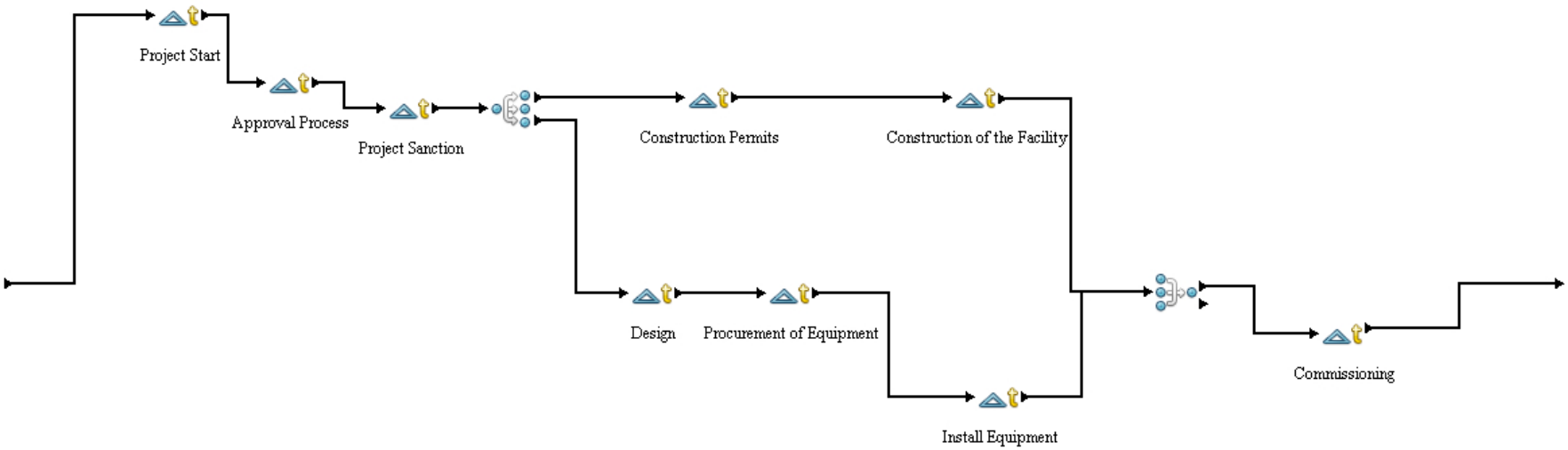
Set Up the Simulation Model

- Import the Project Schedule into the simulation tool
- Run the simulation to get the deterministic results
  - Uses fixed durations for the tasks
  - Uses set resource costs
  - No variability is used to account for estimating inaccuracies
  - No risks are assigned to impact the simulation
  - A single run is sufficient since there is no variability

Top Level Process



Detail Construction Process from the MS Project Import



Deterministic Results

Total Activity Costs[1]	**$424,206,652.76**
Procurement Costs	**$200,000,000.00**
Total Costs	**$624,206,652.76**
End Date[2]	**4/16/2013**

1 – Set costs of labor resources assigned to each task are utilized in the simulation model.

2 - Matches the End Date in the MS Project Schedule

Utilizing Risks

Risk Id	Risk Description	Prob	Prob Compliment
1	Design complexity may challenge engineers	0.400	0.600
2	Site conditions/site access may slow logistics	0.500	0.500
3	Equipment suppliers may be busy	0.600	0.400
4	Capable management may not be assigned	0.400	0.600
5	Environmental agency may be slow	0.500	0.500
-	Activity duration estimates is inaccurate	1.000	1.000
-	Cost estimate is inaccurate	1.000	1.000
6	Key engineering personnel may be unavailable	0.650	0.350

Probability of any one happening is equal to 1 - the compliment of none happening	0.987	
Probability of highest 2 happening	0.390	0.140
Probability of highest 3 happening	0.195	0.070
Probability of highest 4 happening	0.098	0.035
Probability of highest 5 happening	0.039	0.021
Probability of 6 happening	0.016	0.013

Simulation Details

- Simulation was run for 3,000 replications
- Duration and cost was varied on all replications with Triangular Distribution using the min, mode, and max from the 100% risks from the previous chart (accounts for estimation inaccuracies)
- As risks combinations occurred during the replications, additional impacts were applied (compounded) on the min, mode, max values
- Results of the simulations were written to Excel and charted for further analysis

Combination of Risks Simulated

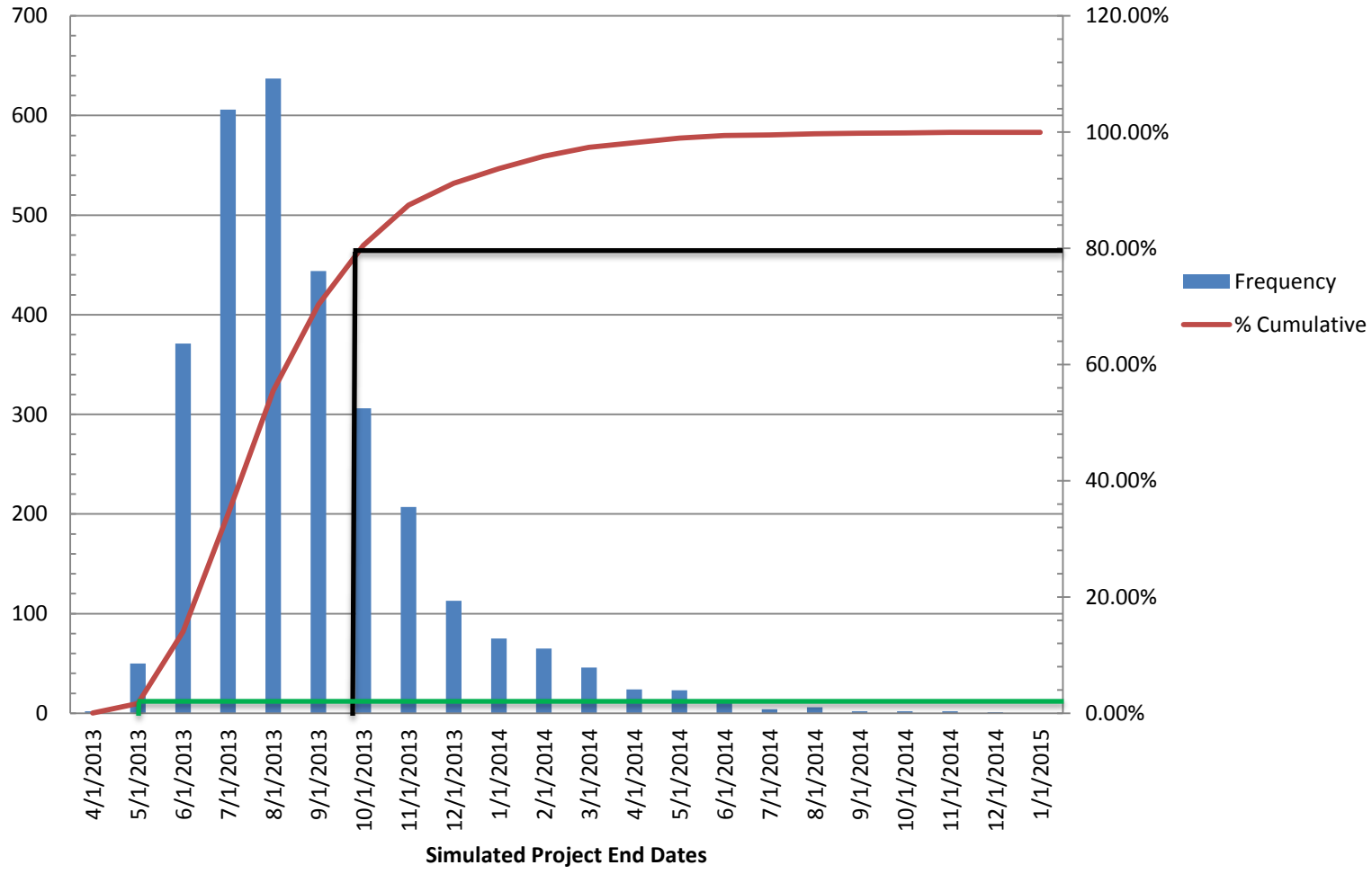
Risk per Replication	Occurrences	% Occurrences
0	31	1%
1	1790	60%
2	570	19%
3	299	10%
4	183	6%
5	74	2%
6	53	2%
Total	**3000**	**100%**

Summary of Simulation Results

Duration Data	
Min Days	825
Mode Days	901
Max Days	1472
Median Days	934
Avg Days	952
Range	647
Earliest Date	04/05/2013
Latest Date	01/12/2015

Cost Data	
Min Cost	$597,554,772
Max Cost	1,018,107,461
Median Cost	688,781,140
Avg Cost	700,036,157
Range	420,552,688

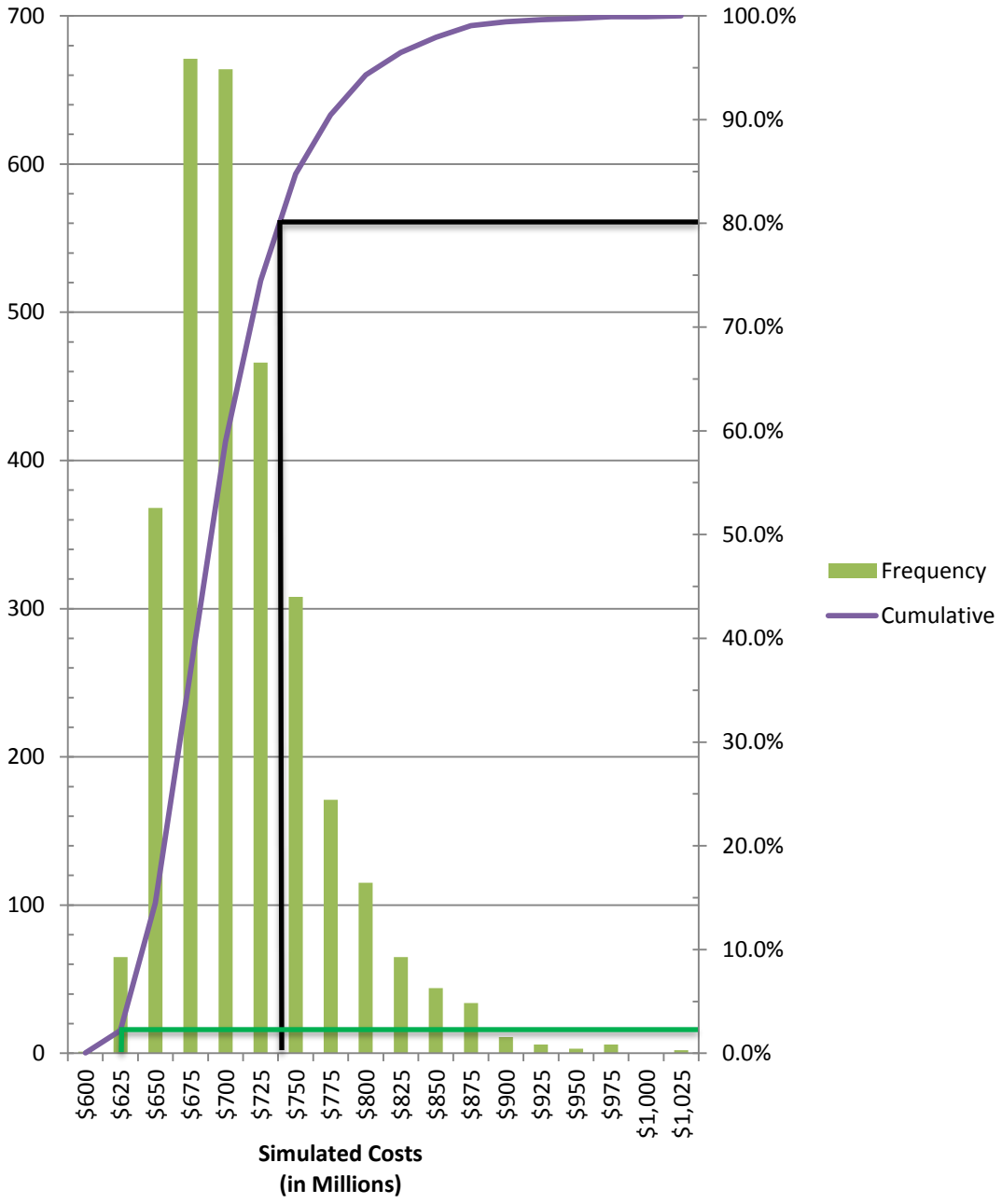
Schedule Analysis



Schedule - Confidence Level Analysis

	Probabilistic					
Deterministic	**P-5**	**P-20**	**P-30**	**P-50**	**P-80**	**P-95**
4/16/2013	5/14/2013	6/11/2013	6/24/2013	7/23/2013	9/27/2013	1/15/2014
Months Needed	0.9	1.9	2.3	3.3	5.5	9.1
% Needed	3.35%	6.70%	8.25%	11.72%	19.62%	32.78%

Cost Analysis



Cost - Confidence Level Analysis

	Probabilistic					
Deterministic	**P-5**	**P-20**	**P-30**	**P-50**	**P-80**	**P-95**
$624,206,653	$633,100,000	$657,250,000	$667,600,000	$688,750,000	$736,750,000	$805,000,000
Dollars Needed	$8,893,347	$33,043,347	$43,393,347	$64,543,347	$112,543,347	$180,793,347
% Needed	1.42%	5.29%	6.95%	10.34%	18.03%	28.96%

Discussion or Questions