Project Schedule and Cost Risk Analysis using Polaris®

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September 2013

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Biographies

David Hulett Ph.D.

- 20 years quantitative schedule risk analysis, integrated cost-schedule risk analysis and project scheduling experience
- Author of risk management chapter in “Guide to the Project Management Body of Knowledge” (PMBOK® Guide)
- Lead for US Government Accountability Office (GAO) Scheduling Best Practices guide
- Author or two industry guides for schedule and integrated cost and schedule risk analysis
- Recognized for “significant contributions to the profession of project scheduling” by PMI College of Scheduling (2010)

Eric Druker CCE/A

- 8 years experience performing cost and schedule risk analysis for DoD, Intelligence, and Civilian government agencies as well as for commercial firms
- Lead for Booz Allen’s RealTime Analytics simulation technology capability (Polaris and Argo)
- Lead for Booz Allen’s JCL (integrated cost and schedule risk analysis) capability
- Performed first two JCLs at NASA
- 2009 and 2013 International Cost Estimating & Analysis Association (ICEAA) Analyst of the Year
- 2-time ICEAA Best Paper Award Winner

Polaris Overview

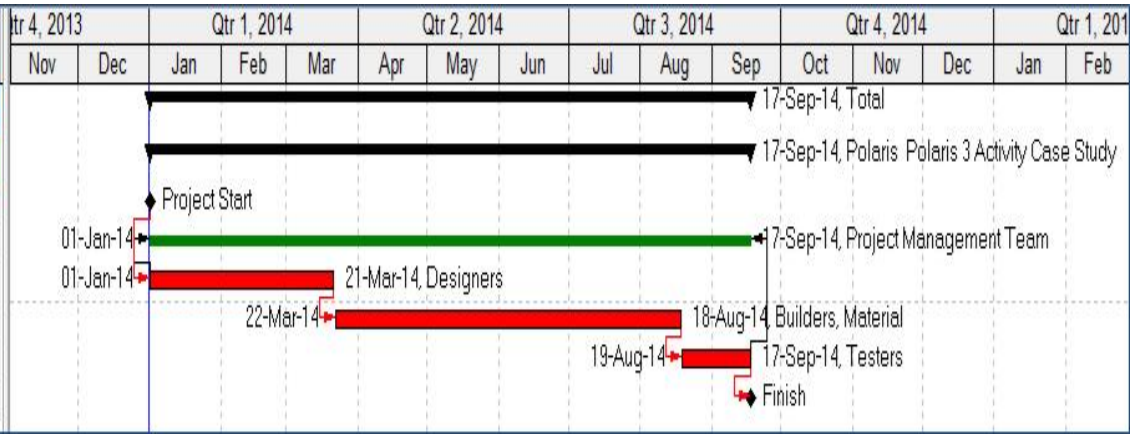
- Prototype built under NASA funding in 2009 to address gap in agency's JCL (integrated cost and schedule risk analysis) capability
  - NASA found that, while several tools *could* do integrated cost and schedule risk analysis it was a primary focus of none of them
- First tool tailor made for integrated cost and schedule risk analysis
  - Compatible with MS Excel, MS Project, Primavera P6, and Active Risk Manager
- Uses Booz Allen's RealTime Analytics Simulation Technology to achieve groundbreaking run-times
- In daily use on over 40 government programs across a variety of DoD, Intel, and Civilian agencies
- Overwhelming demand from government clients led Booz Allen to sell as COTS product in winter 2012

Agenda

- Some risk / uncertainty basics
  - Risk Drivers in series and in parallel
  - Correlation
  - Probabilistic activity
- Offshore Drilling Platform project schedule
- Adding Uncertainty to the activities' durations
- Adding Risk Events from the Risk Register
- Integrating Cost and Schedule Risk Analysis
- Cost Uncertainty
- Cost responds to schedule risk
- Sensitivities
- Cost – completion date scatter diagram

1-Path 4-Activity Schedule

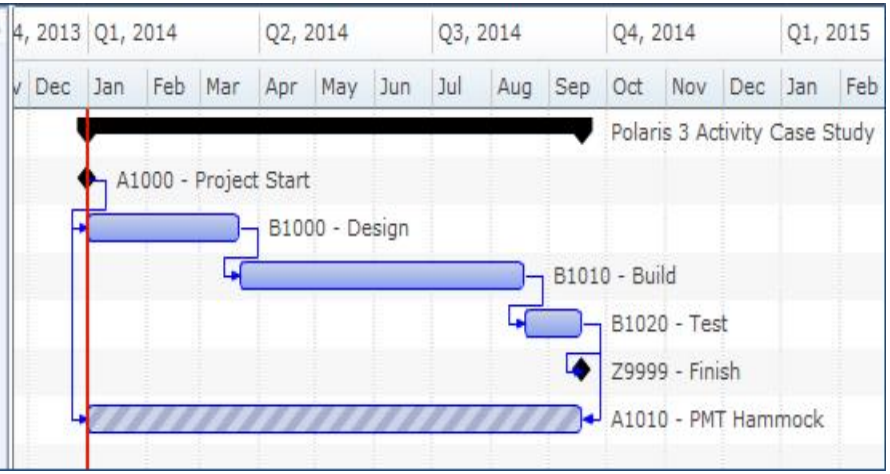
#	Activity ID	Activity Name	Remaining Duration	Start	Finish	Budgeted Total Cost
1	Total		260	01-Jan-14	17-Sep-14	$376,000.00
2	Polaris	Polaris 3 A	260	01-Jan-14	17-Sep-14	$376,000.00
3	A1000	Project Start	0	01-Jan-14		$0.00
4	A1010	PMT Hammock	260	01-Jan-14	17-Sep-14	$40,000.00
5	B1000	Design	80	01-Jan-14	21-Mar-14	$64,000.00
6	B1010	Build	150	22-Mar-14	18-Aug-14	$240,000.00
7	B1020	Test	30	19-Aug-14	17-Sep-14	$32,000.00
8	Z9999	Finish	0		17-Sep-14	$0.00



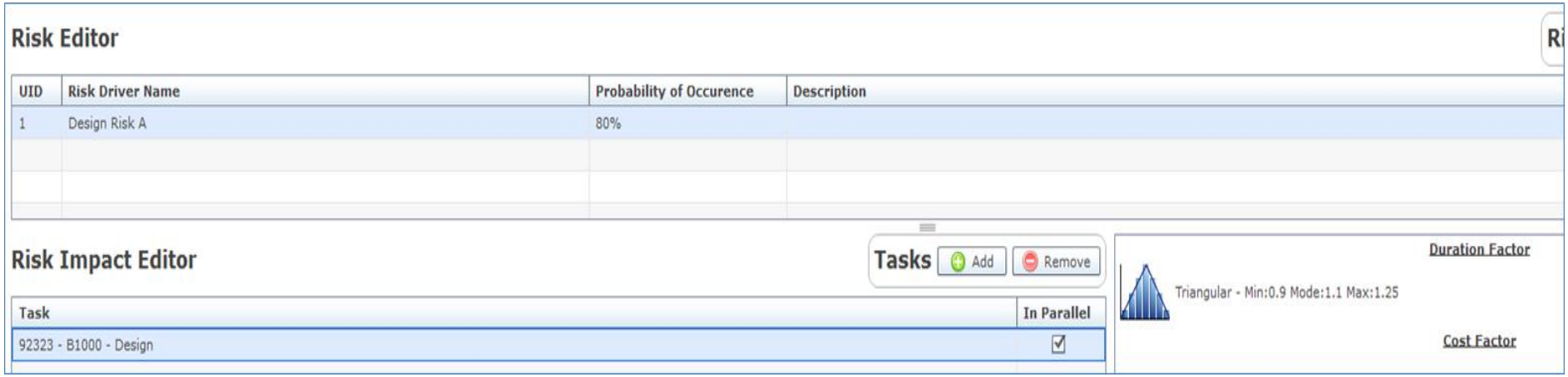
There are 3 task dependent activities that do the work and one hammock (LOE) with the project management team to support the effort

Import to Polaris

UID	Activity	Start Date	End Date	Duration	Cost
29474	▼ Polaris 3 Activity Case Study	1/1/2014	9/17/2014	186	$376,000
92322	A1000 - Project Start	1/1/2014		0	$0
92323	B1000 - Design	1/1/2014	3/21/2014	80	$64,000
92324	B1010 - Build	3/22/2014	8/18/2014	150	$240,000
92325	B1020 - Test	8/19/2014	9/17/2014	30	$32,000
92326	Z9999 - Finish	9/18/2014		0	$0
92327	A1010 - PMT Hammock	1/1/2014	9/17/2014	260	$40,000

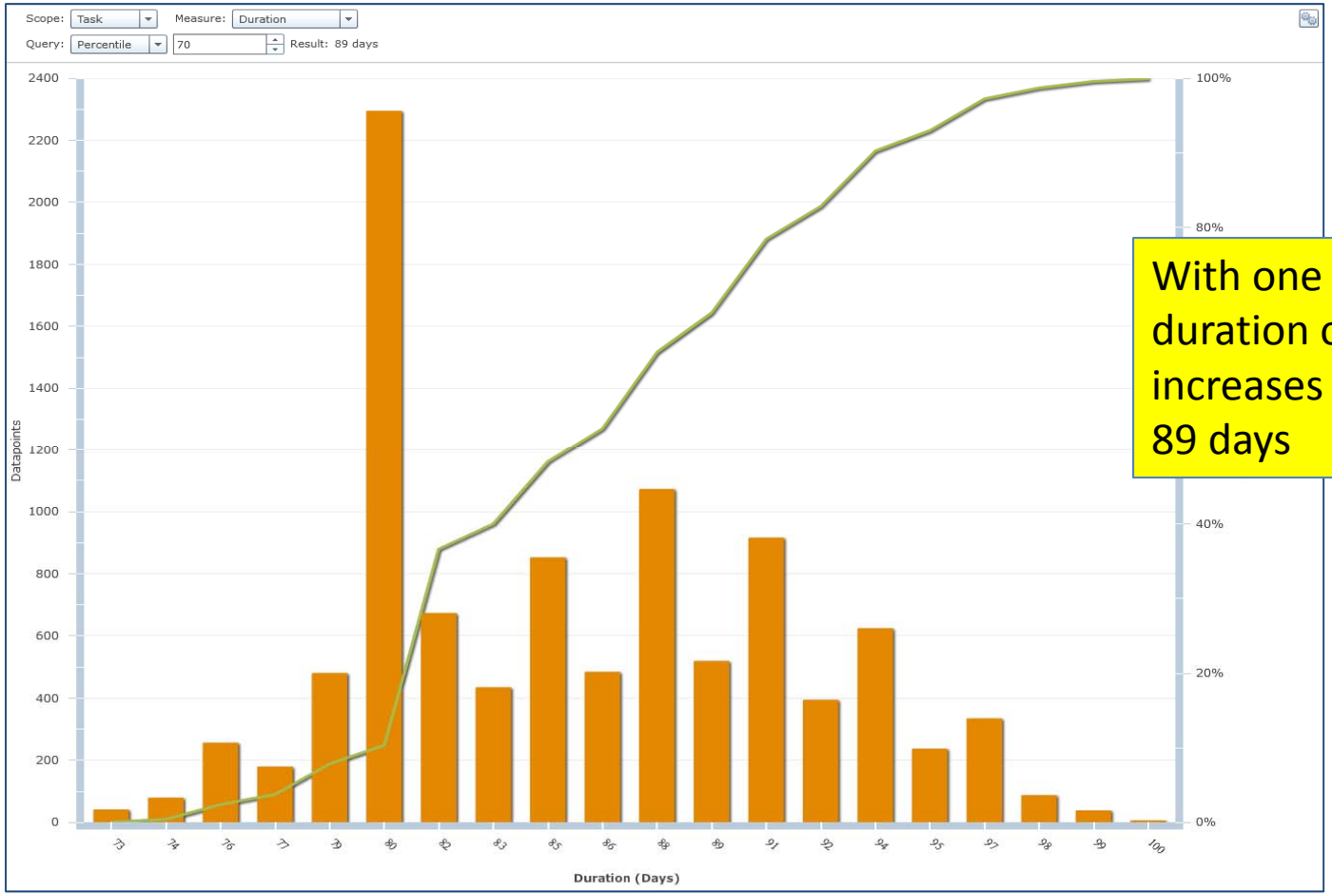


Specify the Risk Driver



In this example the Design Risk A has an 80% likelihood (occurs in 8.000 of 10,000 iterations) and an impact chosen from a triangular distribution of 90% - 110% - 125% of the original 80-day duration if it occurs

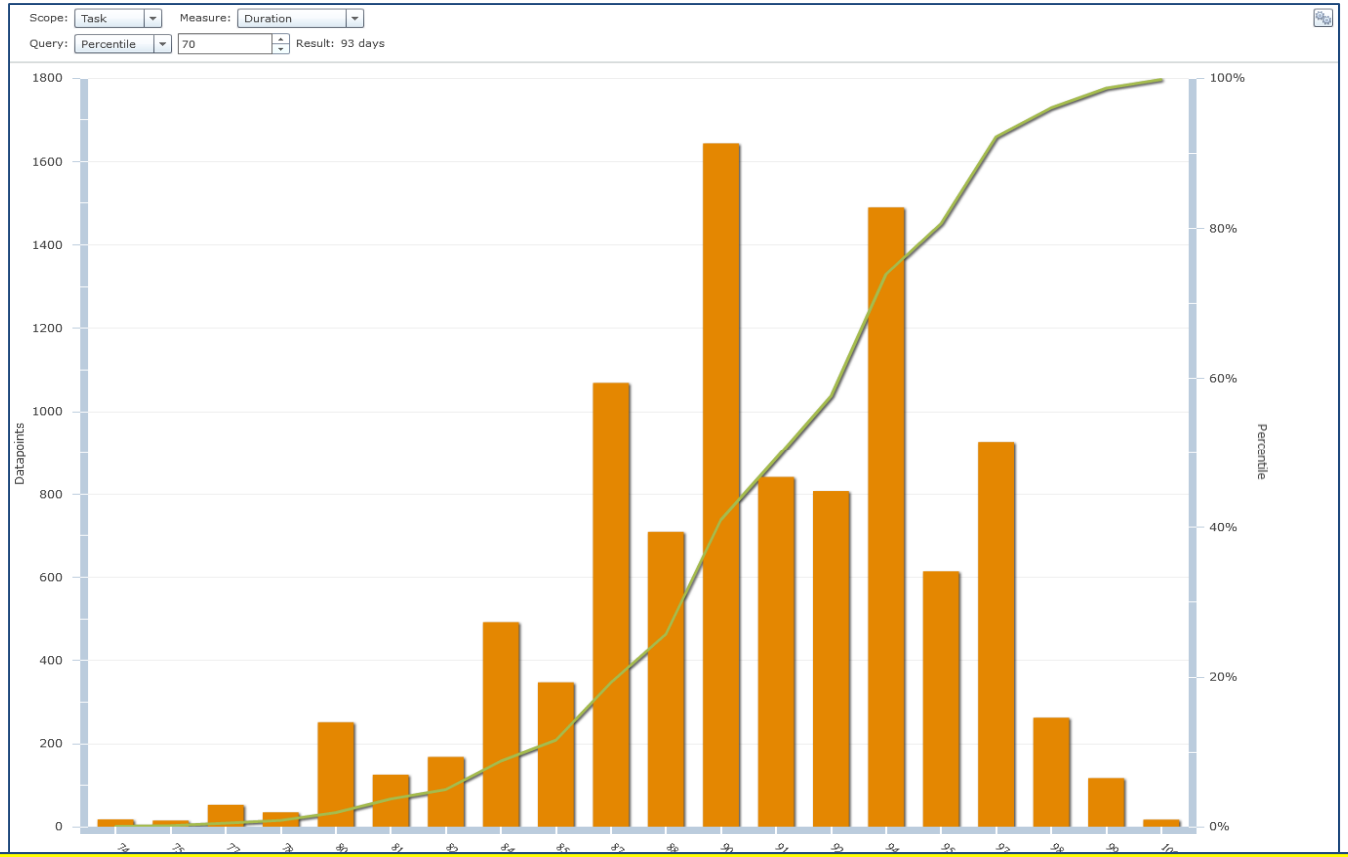
Add a Risk Driver to Design Activity



With one risk the P-80 duration of Design increases from 80 days to 89 days

The histogram “spike” represents the 20% likelihood of the risk’s not happening

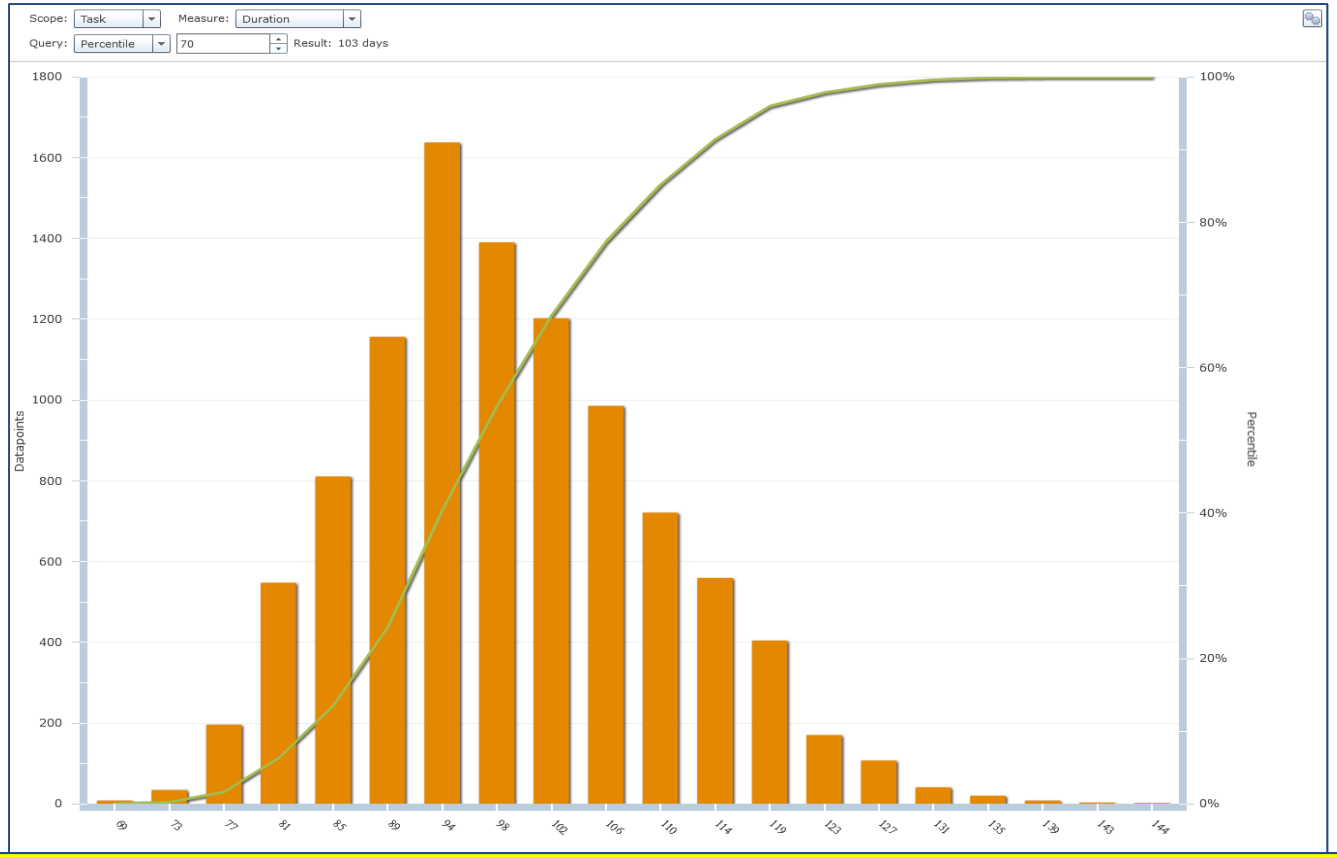
Three Risks Applied to One Activity in Parallel



If the three 80% likely risks are applied in Parallel the P-80 duration for Design is 93 days.

Applying risks in series or parallel only matters when two or more risks occur together in any iteration

Three Risks Applied to One Activity in Series



If the three 80% likely risks are applied in Series the P-80 duration for Design is 103 days.

Applying risks in series or parallel only matters when two or more risks occur together in any iteration

Adding Risk Drivers to the 3 Activities

Risk Editor

UID	Risk Driver Name	Probability of Occurence	Description
1	Design Risk	80%	
2	Build Risk	80%	
3	Test Risk	80%	

Risk Impact Editor

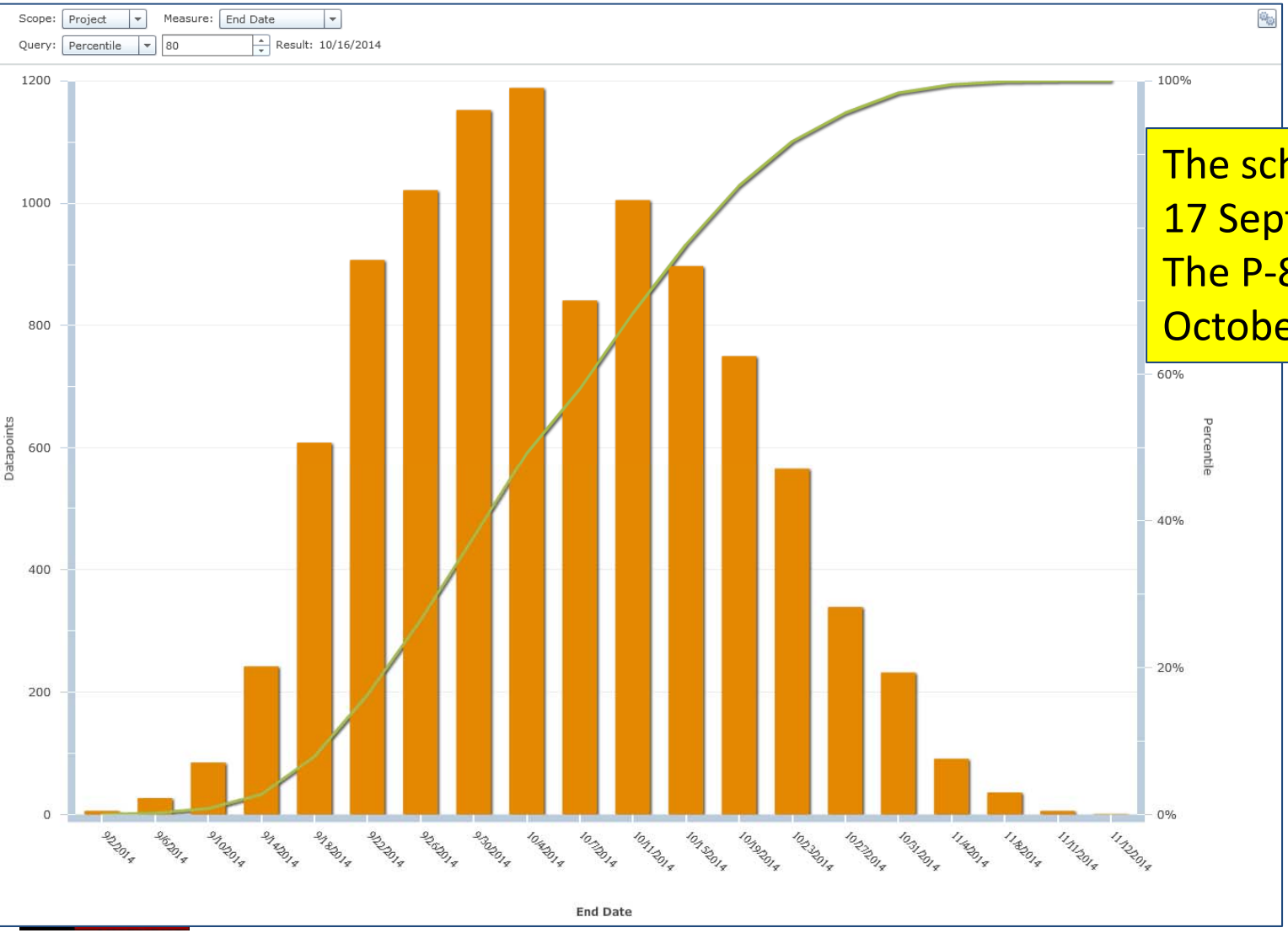
Tasks Add Remove

Triangular - Min:0.9 Mode:1.1 Max:1.25

Task	In Parallel
92324 - B1010 - Build	☐

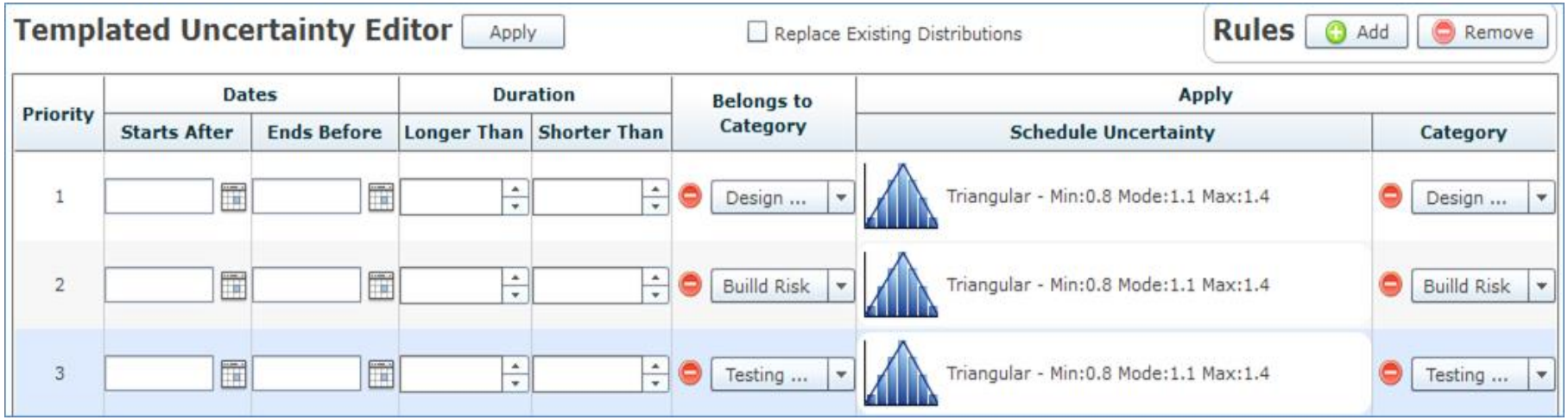
For simplicity, each risk driver has 80% probability of occurring and impacts of 90% - 110% - 125%. Each activity has only one risk assigned

One Path, Three Activities, Three Risks



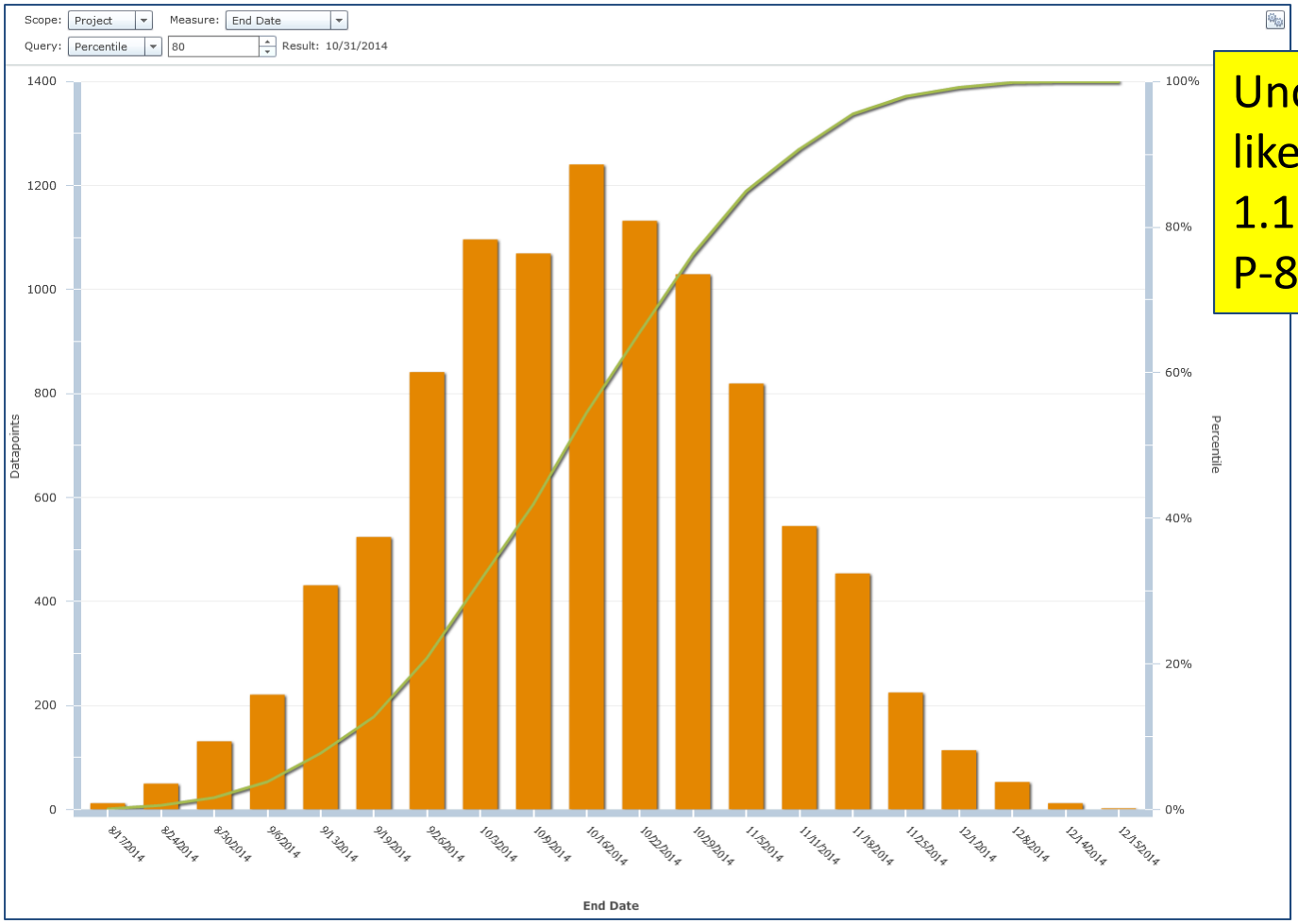
The schedule date is 17 September 2013
The P-80 date is 16 October 2014

Uncertainty Applied to All Activities



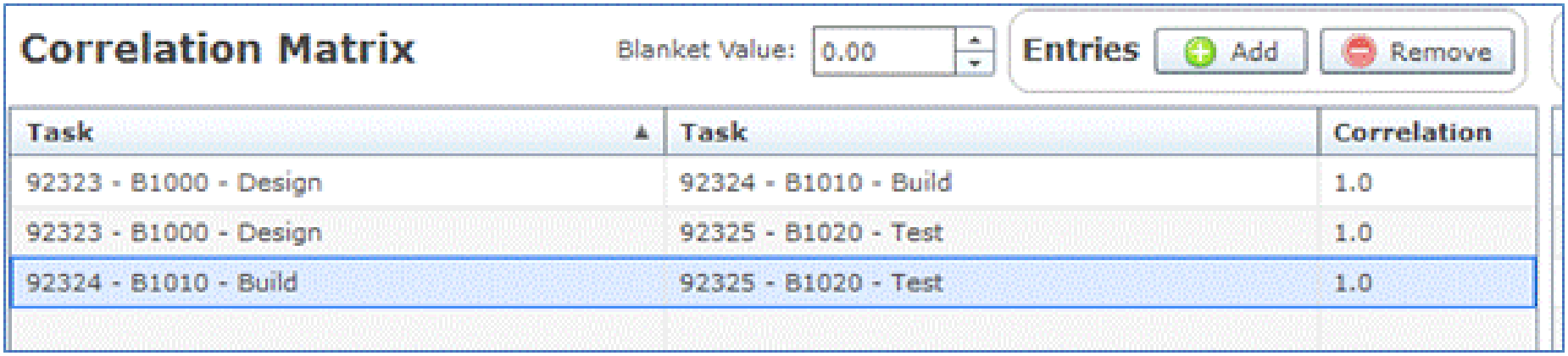
Templated Uncertainty applies 3-point estimates (or other distributions) directly to the activities' durations. 100% likely. Different ranges can be placed on different types of activities using Category

Schedule Risk from Uncertainty
No Correlation



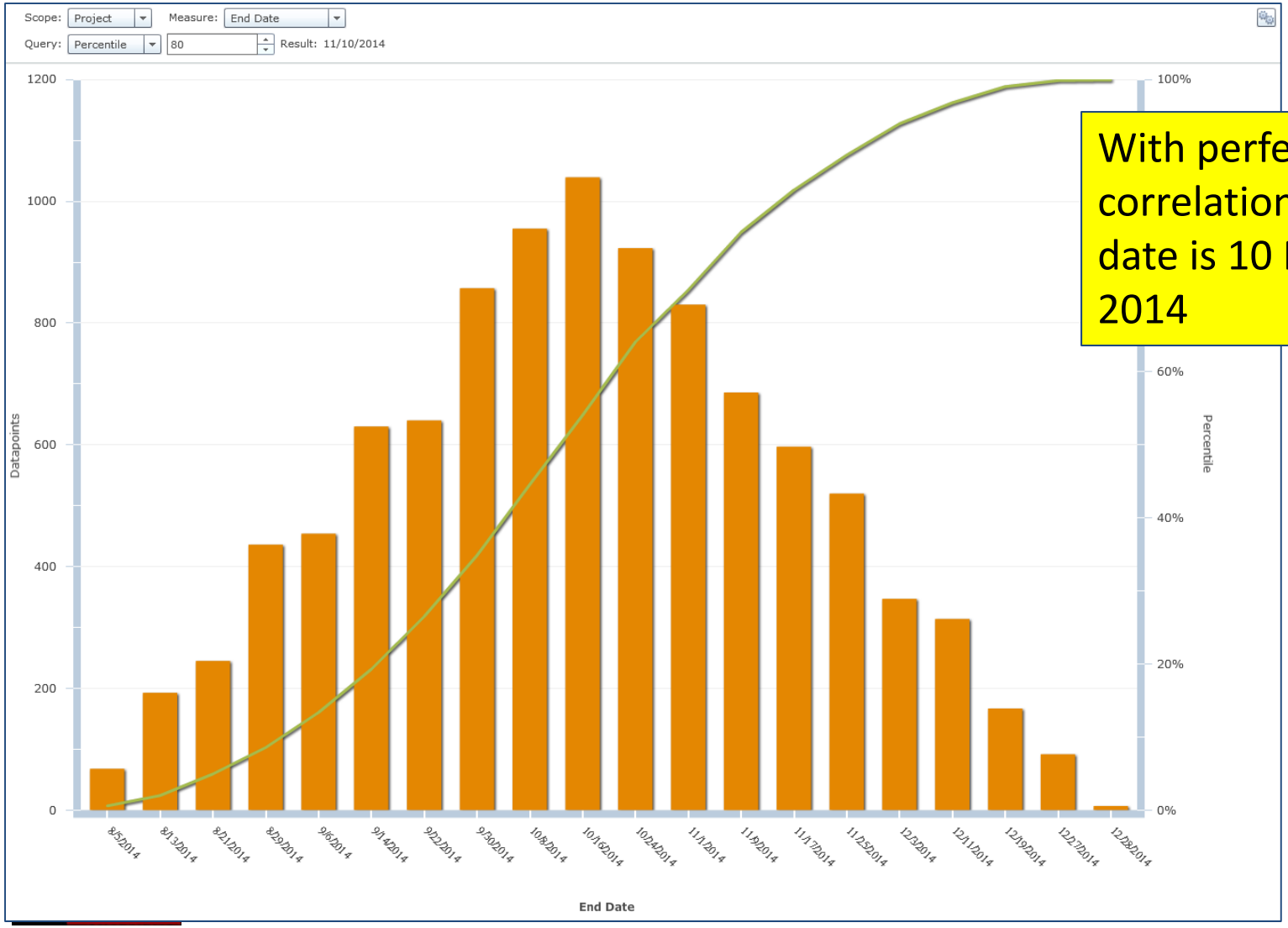
Uncertainty (100% likely) of triangular .8 – 1.1 – 1.4 no correlation
P-80 is 31 October 2014

Add Correlation to the Uncertainty



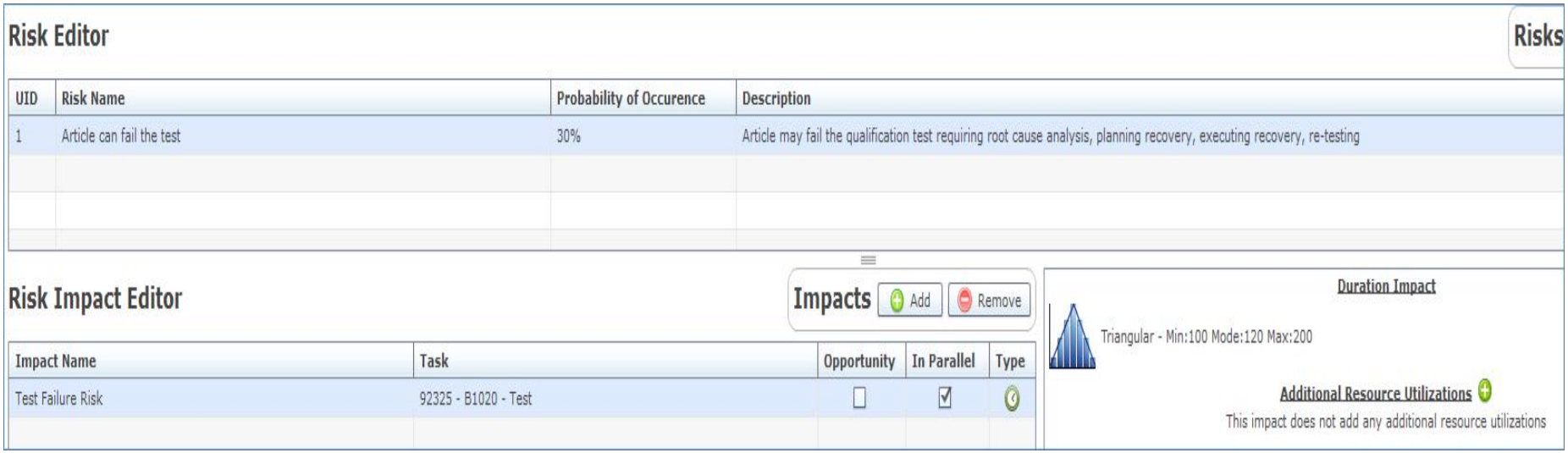
In this case correlation is applied directly to the uncertain durations. We have chosen 100% correlation as the maximum, but that is the user's choice.
Also all 3 activities' durations are correlated, the strongest correlation available

Schedule Risk Uncertainty Adding 100% Correlation



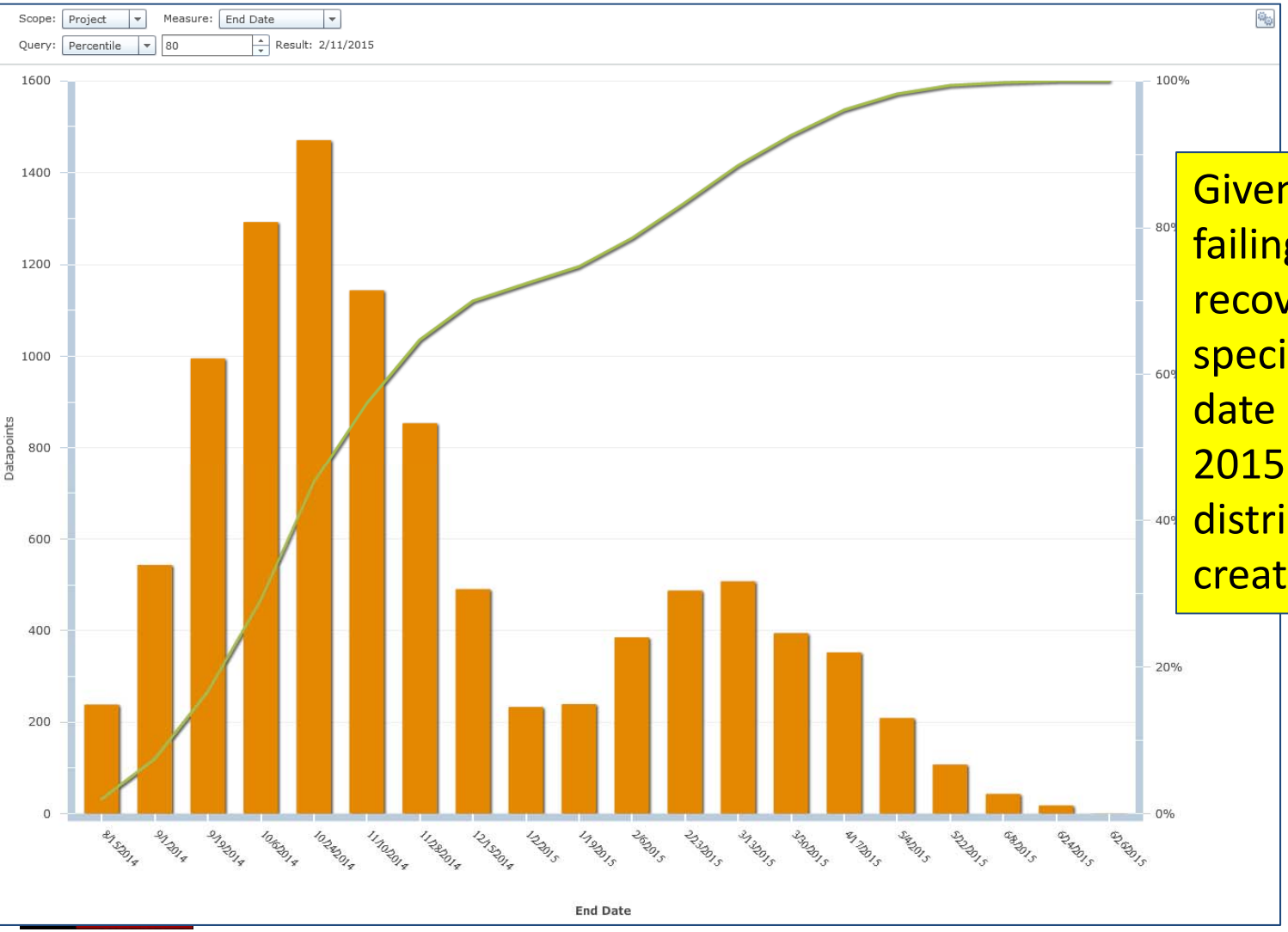
With perfect (100%) correlation the P-80 date is 10 November 2014

Add the Prospect of Failing the Test



Use a discrete risk with an impact measured in days to add a discrete duration to the testing activity, here with a 30% probability and a recovery time of 100d – 120d 200d

Possibility of Failing the Test



Given a 30% chance of failing the test and a recovery period as specified, the P-80 date is 11 February 2015. A bi-modal distribution may be created

Next Steps

- Interest in conducting Polaris pilot?

Contact Information

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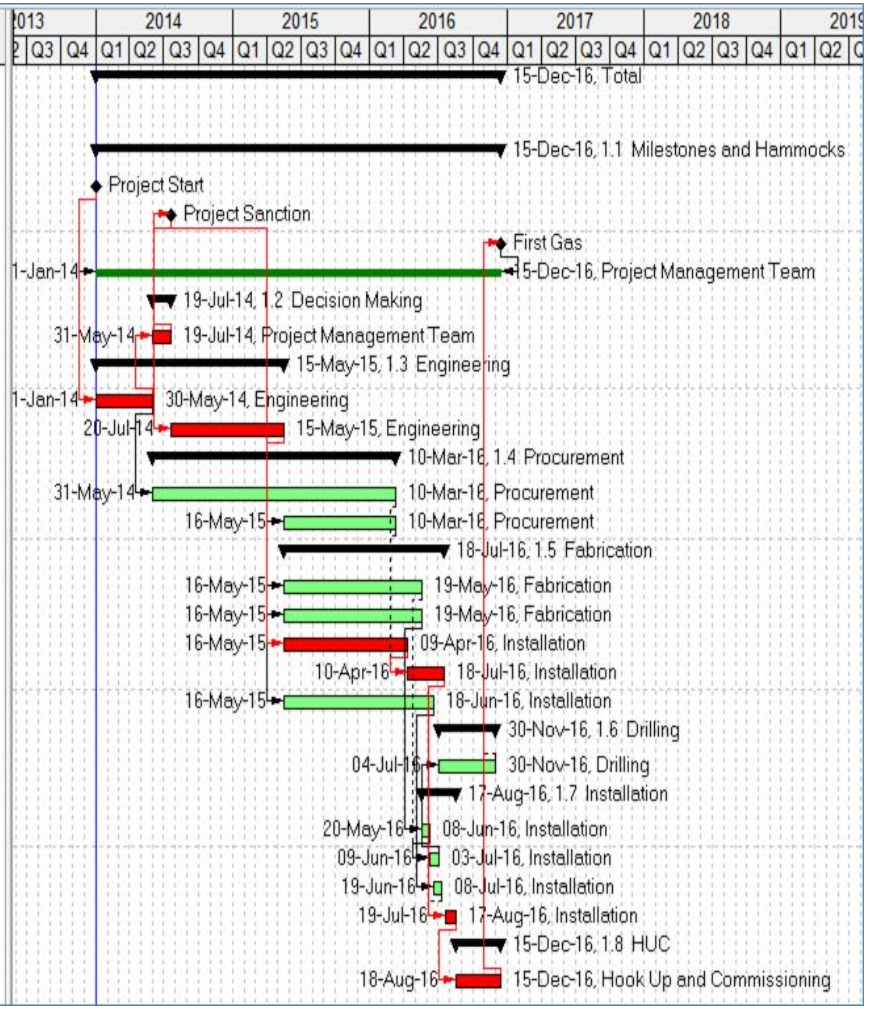
ADDITIONAL ANALYSIS

Offshore Gas Production Platform Primavera P6 Schedule with Costs

Activity ID	Activity Name	Remaining Duration	Start	Finish	Budgeted Total Cost	Total Float
Total		772	01-Jan-14	15-Dec-16	$1,648,200.00	0
1	Offshore Gas Production Platform	0			$0.00	0
1.1	**Milestones and Hammocks**	1080	01-Jan-14	15-Dec-16	$200,000.00	0
A1000	Project Start	0	01-Jan-14		$0.00	0
A1010	Project Sanction	0		19-Jul-14	$0.00	0
A1020	First Gas	0		15-Dec-16	$0.00	0
A1030	Project Management Hammock	1080	01-Jan-14	15-Dec-16	$200,000.00	0
1.2	**Decision Making**	50	31-May-14	19-Jul-14	$80,000.00	0
B1000	Approval Process	50	31-May-14	19-Jul-14	$80,000.00	0
1.3	**Engineering**	500	01-Jan-14	15-May-15	$96,000.00	0
C1000	FEED	150	01-Jan-14	30-May-14	$16,000.00	0
C1010	Detailed Engineering	300	20-Jul-14	15-May-15	$80,000.00	0
1.4	**Procurement**	650	31-May-14	10-Mar-16	$425,000.00	30
D1000	Procurement of LLE	650	31-May-14	10-Mar-16	$250,000.00	30
D1010	Procurement of Other Equipment	300	16-May-15	10-Mar-16	$175,000.00	30
1.5	**Fabrication**	430	16-May-15	18-Jul-16	$656,000.00	0
E1000	Fabricate Drilling Topsides	370	16-May-15	19-May-16	$160,000.00	35
E1010	Fabricate Drilling Jacket	370	16-May-15	19-May-16	$80,000.00	15
E1020	Fabricate CPP Topsides	330	16-May-15	09-Apr-16	$240,000.00	0
E1025	Install LLE and Other Equipment	100	10-Apr-16	18-Jul-16	$80,000.00	0
E1030	Fabricate CPP Jacket	400	16-May-15	18-Jun-16	$96,000.00	10
1.6	**Drilling**	150	04-Jul-16	30-Nov-16	$80,000.00	15
F1000	Drilling for First Gas	150	04-Jul-16	30-Nov-16	$80,000.00	15
1.7	**Installation**	90	20-May-16	17-Aug-16	$47,200.00	0
G1000	Install Drilling Platform Jacket	20	20-May-16	08-Jun-16	$8,000.00	15
G1010	Install Drilling Topsides	25	09-Jun-16	03-Jul-16	$13,600.00	15
G1020	Install CPP Jacket	20	19-Jun-16	08-Jul-16	$9,600.00	10
G1030	Install CPP Topsides	30	19-Jul-16	17-Aug-16	$16,000.00	0
1.8	**HUC**	120	18-Aug-16	15-Dec-16	$64,000.00	0
H1000	Hook UP and Commissioning for Fir	120	18-Aug-16	15-Dec-16	$64,000.00	0



Resources

Resource Name	Resource Type	Price / Unit	Calendar
Project Management Team	Labor	$100.00/h	7 Day
Procurement	Material	$100.00/unit	7 Day
Installation	Labor	$100.00/h	7 Day
Hook Up and Commissioning	Labor	$100.00/h	7 Day
Fabrication	Labor	$100.00/h	7 Day
Engineering	Labor	$100.00/h	7 Day
Drilling	Labor	$100.00/h	7 Day

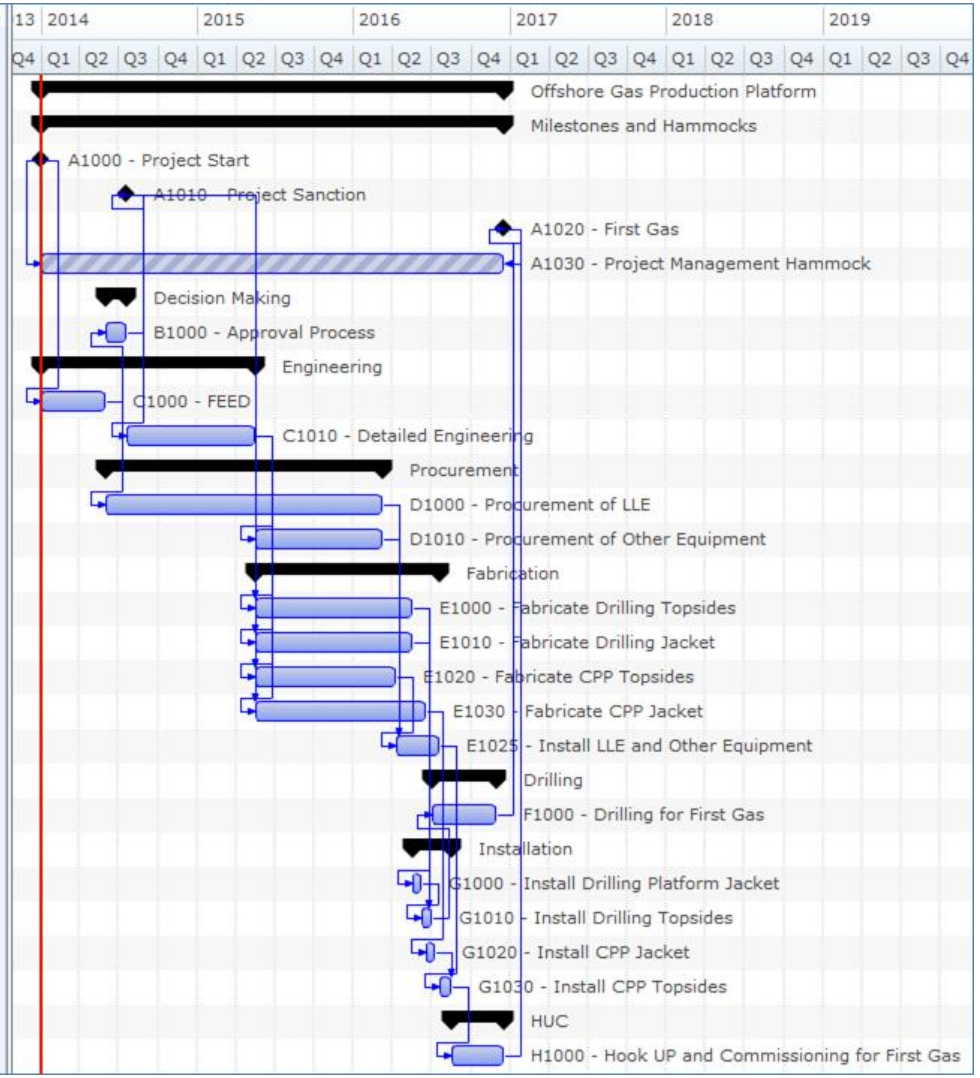
Resources are generalized and intended to put the entire (not-risk-adjusted) budget into the schedule

Resources are designated Labor or Material. Labor resources are cost time-dependent and will cost more if the activity takes longer. Material resources are cost time-independent, may be risky but not because of schedule risk

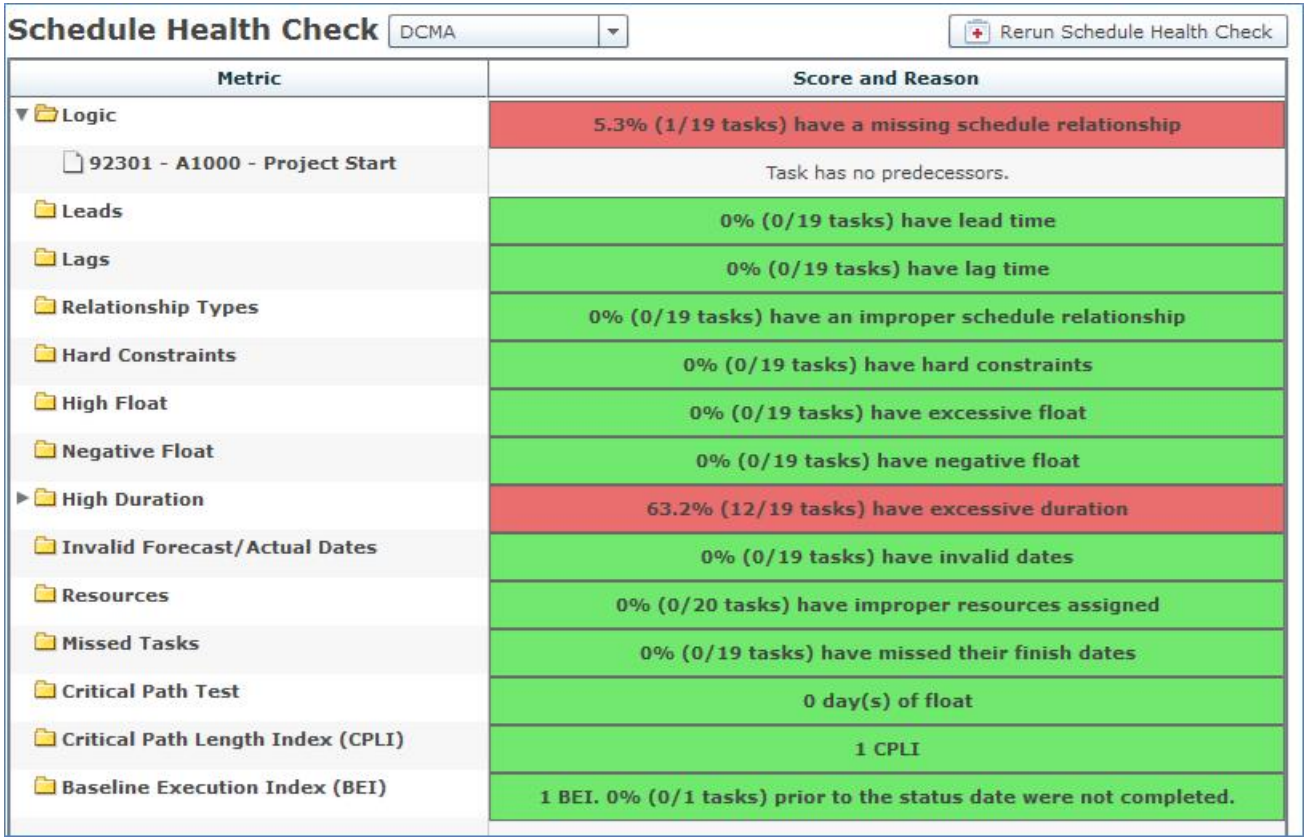
These resources and the activity durations are based on 7-day calendars to avoid any weekend effects. Of course Polaris can handle calendars.

Schedule Imported into Polaris

UID	Activity	Start Date	End Date	Duration	Cost
29459	▼ Offshore Gas Production Platfori	1/1/2014	12/15/2016	772	$1.65M
29460	▼ Milestones and Hammocks	1/1/2014	12/15/2016	772	$200,000
92301	A1000 - Project Start	1/1/2014		0	$0
92302	A1010 - Project Sanction	7/20/2014		0	$0
92303	A1020 - First Gas	12/16/2016		0	$0
92320	A1030 - Project Managem	1/1/2014	12/15/2016	1,080	$200,000
29467	▼ Decision Making	5/31/2014	7/19/2014	35	$80,000
92304	B1000 - Approval Process	5/31/2014	7/19/2014	50	$80,000
29468	▼ Engineering	1/1/2014	5/15/2015	358	$96,000
92305	C1000 - FEED	1/1/2014	5/30/2014	150	$16,000
92306	C1010 - Detailed Engineei	7/20/2014	5/15/2015	300	$80,000
29469	▼ Procurement	5/31/2014	3/10/2016	464	$425,000
92307	D1000 - Procurement of L	5/31/2014	3/10/2016	650	$250,000
92308	D1010 - Procurement of C	5/16/2015	3/10/2016	300	$175,000
29470	▼ Fabrication	5/16/2015	7/18/2016	306	$656,000
92309	E1000 - Fabricate Drilling	5/16/2015	5/19/2016	370	$160,000
92310	E1010 - Fabricate Drilling	5/16/2015	5/19/2016	370	$80,000
92311	E1020 - Fabricate CPP Top	5/16/2015	4/9/2016	330	$240,000
92312	E1030 - Fabricate CPP Jac	5/16/2015	6/18/2016	400	$96,000
92321	E1025 - Install LLE and Ot	4/10/2016	7/18/2016	100	$80,000
29471	▼ Drilling	7/4/2016	11/30/2016	108	$80,000
92313	F1000 - Drilling for First G	7/4/2016	11/30/2016	150	$80,000
29472	▼ Installation	5/20/2016	8/17/2016	64	$47,200
92314	G1000 - Install Drilling Pla	5/20/2016	6/8/2016	20	$8,000
92315	G1010 - Install Drilling To	6/9/2016	7/3/2016	25	$13,600
92316	G1020 - Install CPP Jacke	6/19/2016	7/8/2016	20	$9,600
92317	G1030 - Install CPP Topsi	7/19/2016	8/17/2016	30	$16,000
29473	▼ HUC	8/18/2016	12/15/2016	86	$64,000
92319	H1000 - Hook UP and Con	8/18/2016	12/15/2016	120	$64,000



Schedule Health Check

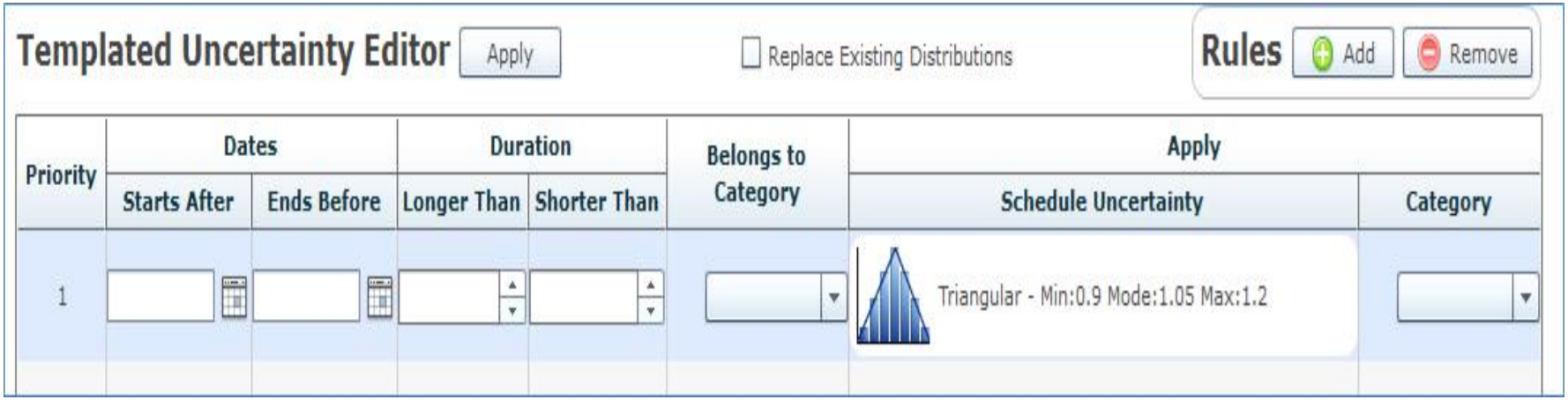


Schedule Health Check DCMA — Rerun Schedule Health Check

Metric	Score and Reason
Logic	5.3% (1/19 tasks) have a missing schedule relationship
92301 - A1000 - Project Start	Task has no predecessors.
Leads	0% (0/19 tasks) have lead time
Lags	0% (0/19 tasks) have lag time
Relationship Types	0% (0/19 tasks) have an improper schedule relationship
Hard Constraints	0% (0/19 tasks) have hard constraints
High Float	0% (0/19 tasks) have excessive float
Negative Float	0% (0/19 tasks) have negative float
High Duration	63.2% (12/19 tasks) have excessive duration
Invalid Forecast/Actual Dates	0% (0/19 tasks) have invalid dates
Resources	0% (0/20 tasks) have improper resources assigned
Missed Tasks	0% (0/19 tasks) have missed their finish dates
Critical Path Test	0 day(s) of float
Critical Path Length Index (CPLI)	1 CPLI
Baseline Execution Index (BEI)	1 BEI. 0% (0/1 tasks) prior to the status date were not completed.

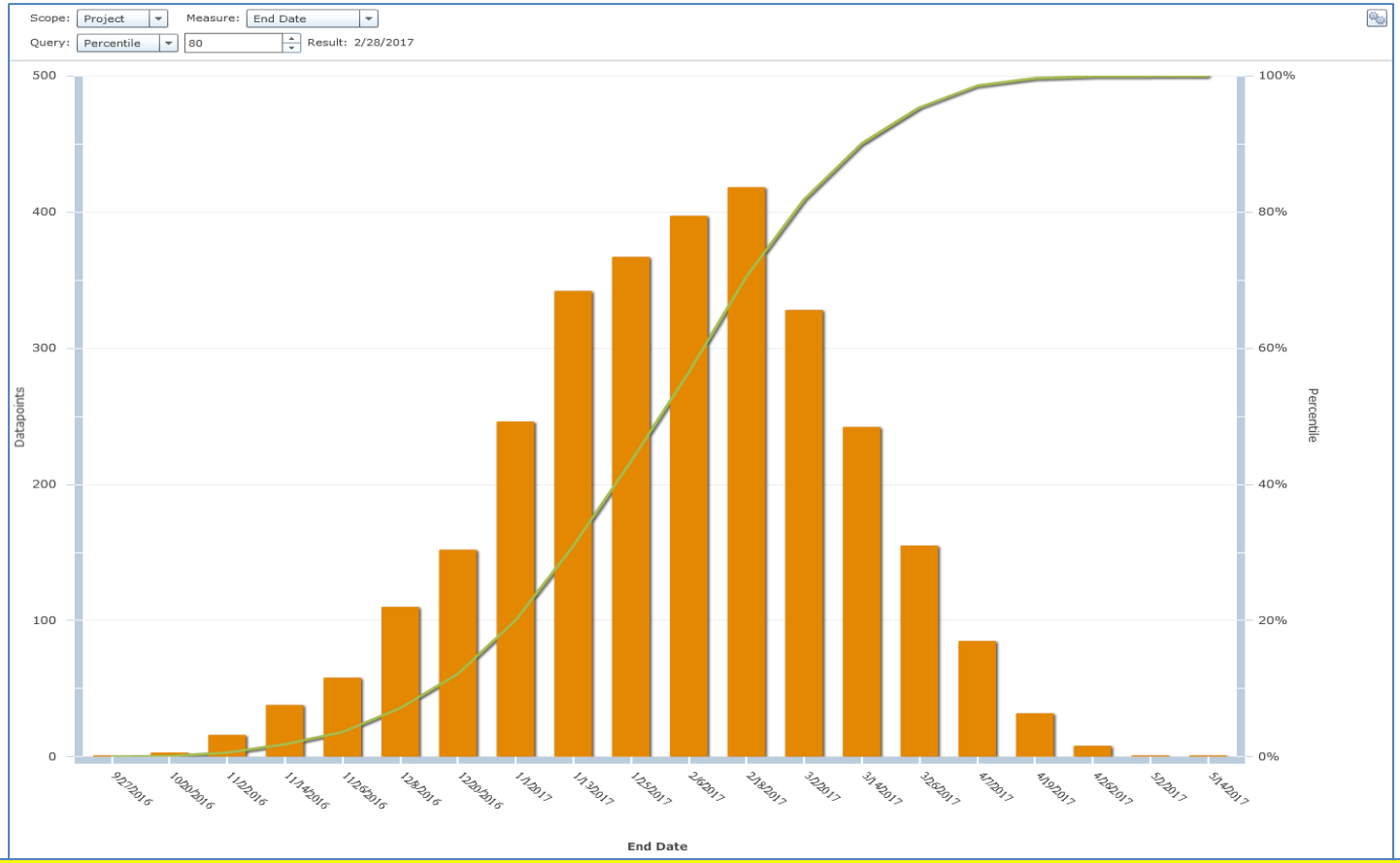
Details, such as “Task has no predecessors” are shown.
The “High Duration” is highlighted. Activities are long because the schedule is summary with 3 years’ duration shown in 17 activities and 3 milestones

Add Basic Uncertainty and Estimating Error to Schedule Durations



This range (.9 – 1.05 – 1.2) represents basic uncertainty and a slightly-biased estimating error. These will probably have to be lived with since they are inherent, not events that can be mitigated. These will be applied to all activities or can be applied differentially to activity types as reference ranges.

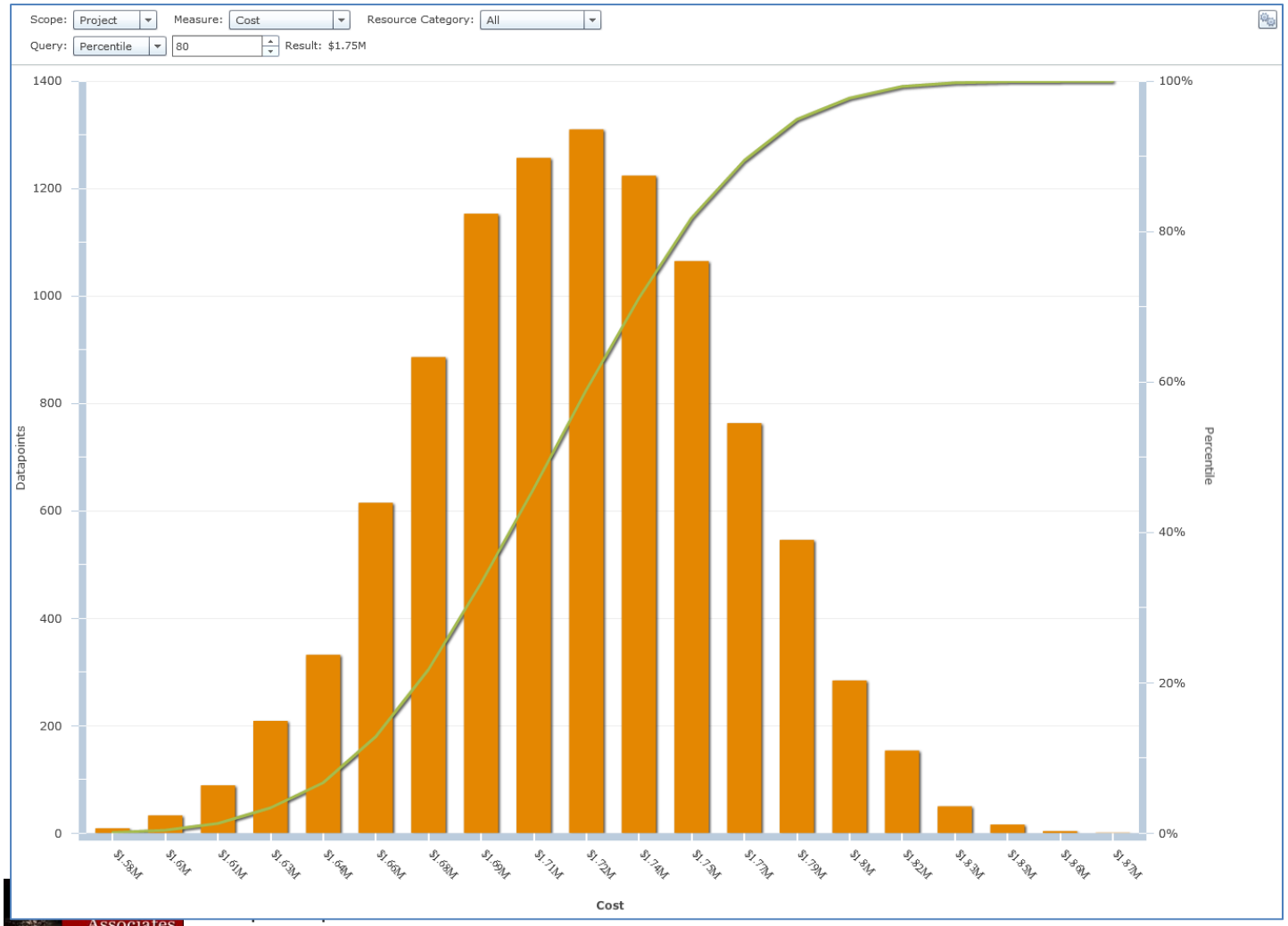
Schedule Risk with Inherent Uncertainty and Duration Estimating Bias



Schedule Date is 15 December 2016
P-80 is 28 March 2017, 3 ½ months later

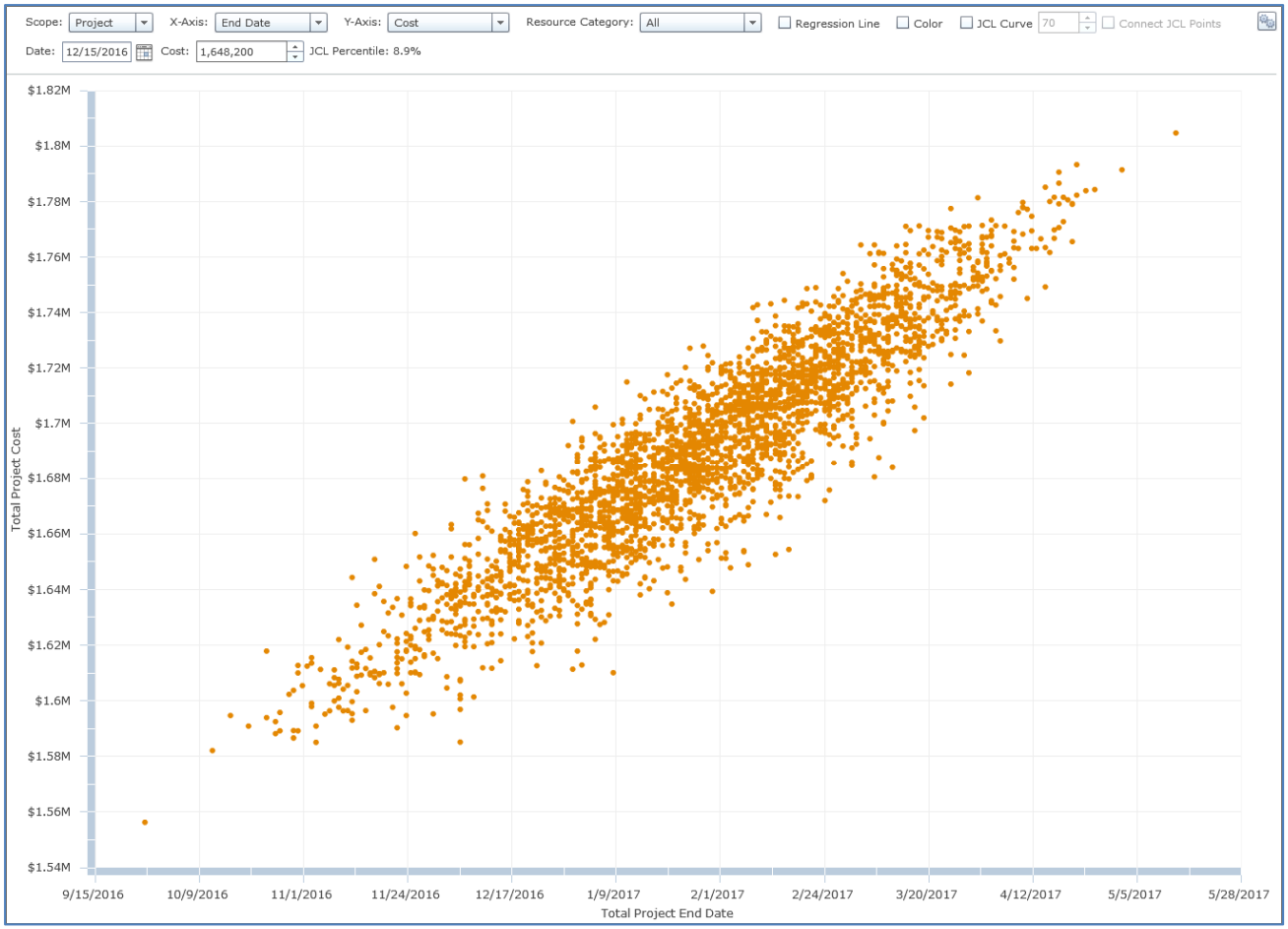
The P-9- date of 28 March 2017 uses the default correlation value of 30%. With correlation at 0% the date is 20 March 2017. With 100% correlation it is 5 April 2017

Cost Risk with Uncertainty and Schedule Estimating Error Only



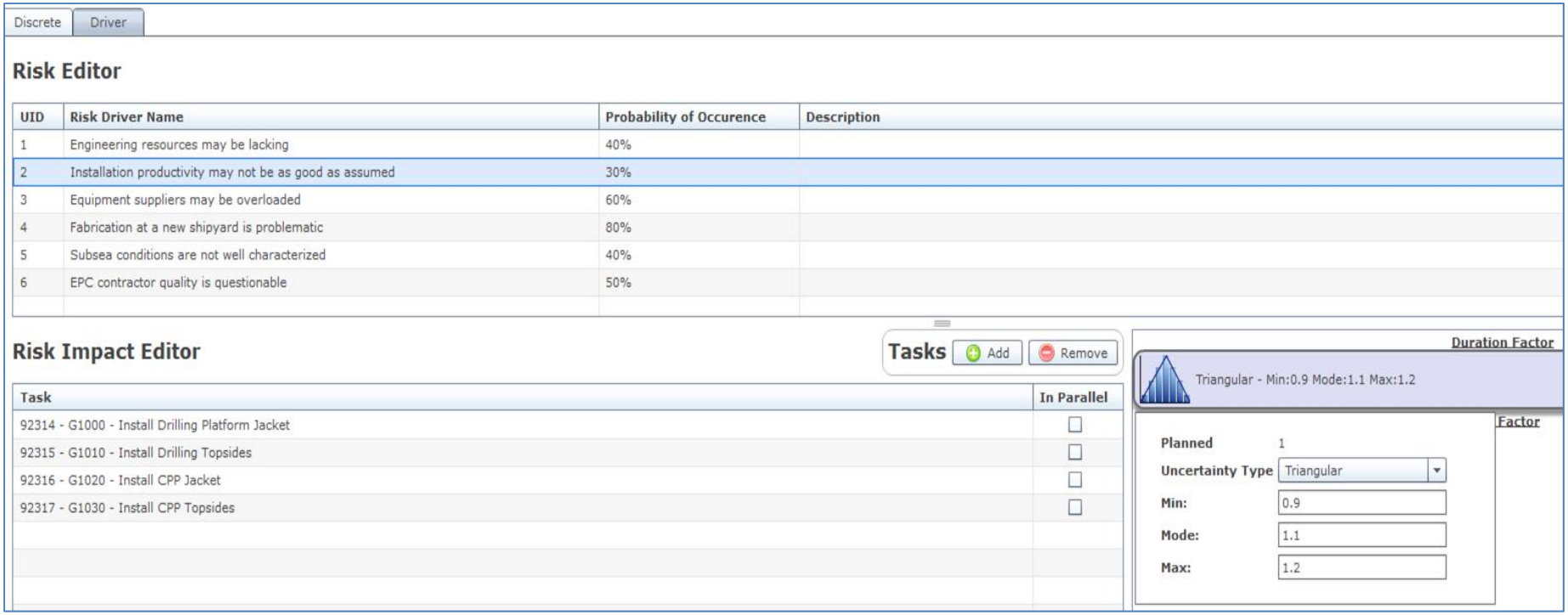
Cost Estimate is $1.65 billion P-80 is $1.75 billion with uncertainty and schedule estimating error

Cost – Finish Date Scatter



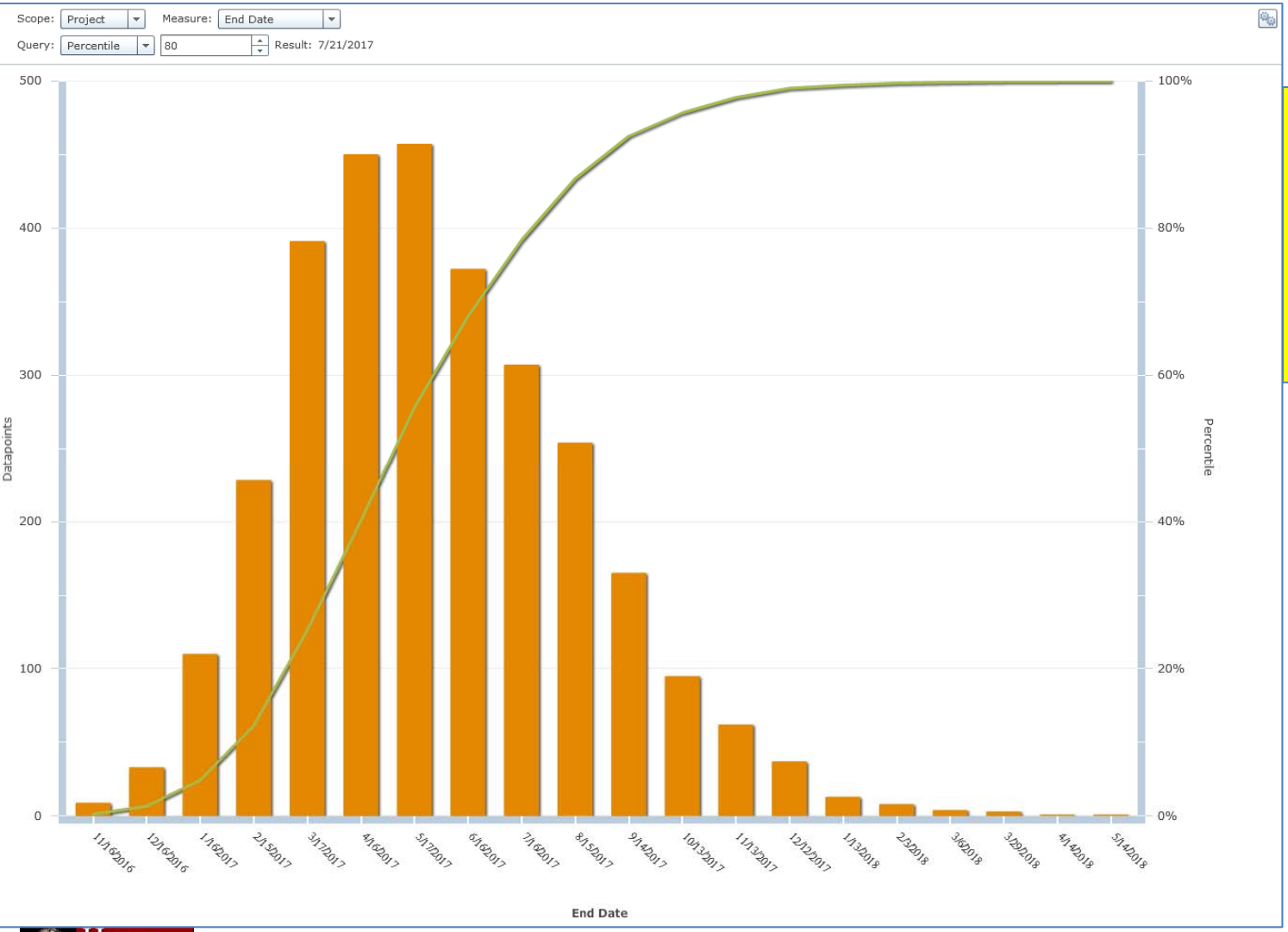
Cost and time are 92% correlated since cost varies only as durations cause time-dependent resource cost to vary

Add Risk Drivers & Apply to Activities' Durations



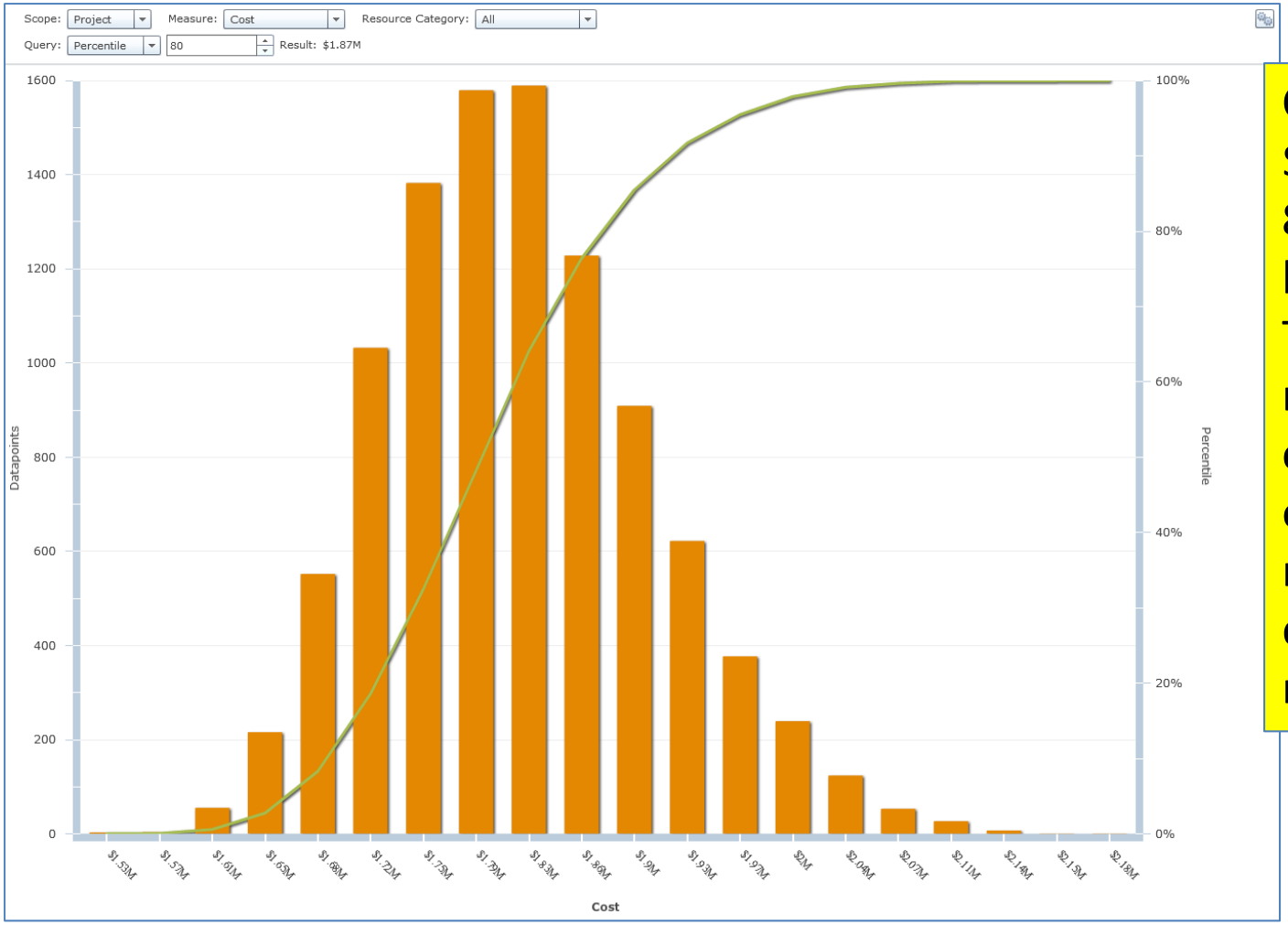
Here, the risk "Installation productivity may not be as good as assumed" is assigned to all 4 Installation activities. It is assigned 30% probability and a triangular distribution with multiplicative factors of .9 - 1.1 - 1.20. For simplicity all Risk Drivers have the same impact but they have their own probabilities.

Schedule Risk with Risk Drivers Added



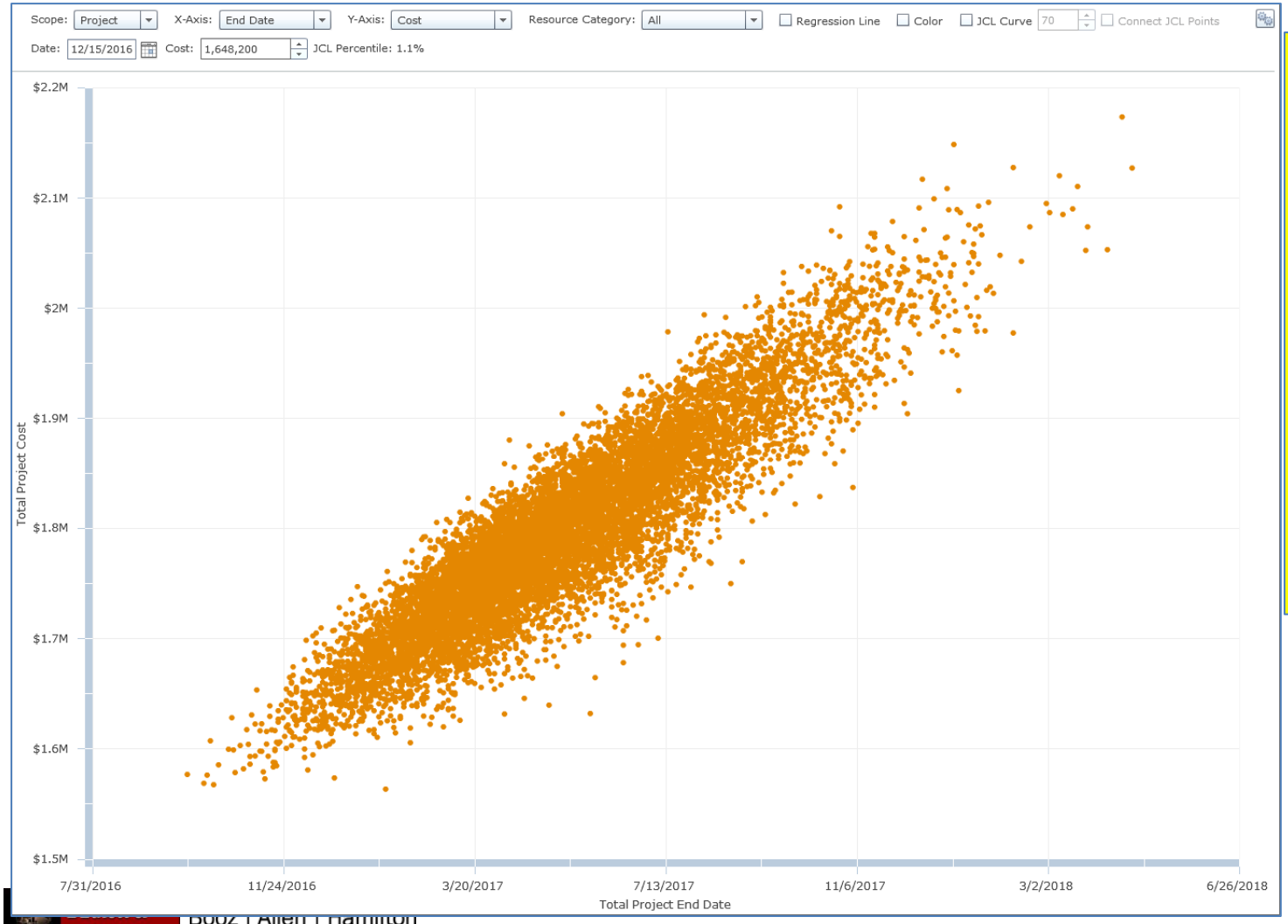
The P-80 date is now 21 July 2017. The Risk Drivers added nearly 4 months

Cost Risk with Schedule Risk Drivers



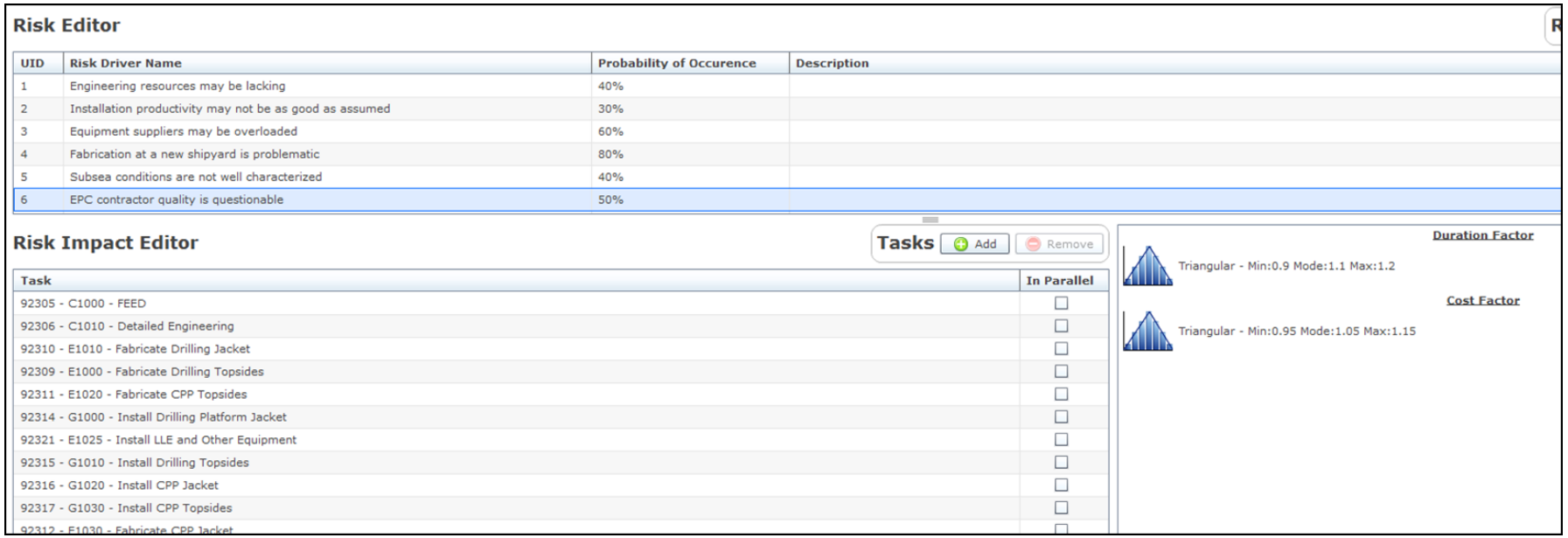
Cost risk is now $1.87 billion at P-80, all due to longer durations There is no cost risk except that caused by the effect of schedule risk on time-dependent resources

Cost – Finish Date Scatter with Schedule Risk Drivers Added



There is no cost risk except that caused by the effect of schedule risk on time-dependent resources. Cost finish date correlation is 92%

Add Cost Burn Rate Uncertainty for Risk Drivers with Labor Resources



Risk Editor

UID	Risk Driver Name	Probability of Occurence	Description
1	Engineering resources may be lacking	40%	
2	Installation productivity may not be as good as assumed	30%	
3	Equipment suppliers may be overloaded	60%	
4	Fabrication at a new shipyard is problematic	80%	
5	Subsea conditions are not well characterized	40%	
6	EPC contractor quality is questionable	50%	

Risk Impact Editor

Tasks Add Remove

Task	In Parallel
92305 - C1000 - FEED	☐
92306 - C1010 - Detailed Engineering	☐
92310 - E1010 - Fabricate Drilling Jacket	☐
92309 - E1000 - Fabricate Drilling Topsides	☐
92311 - E1020 - Fabricate CPP Topsides	☐
92314 - G1000 - Install Drilling Platform Jacket	☐
92321 - E1025 - Install LLE and Other Equipment	☐
92315 - G1010 - Install Drilling Topsides	☐
92316 - G1020 - Install CPP Jacket	☐
92317 - G1030 - Install CPP Topsides	☐
92312 - E1030 - Fabricate CPP Jacket	☐

Duration Factor

Triangular - Min:0.9 Mode:1.1 Max:1.2

Cost Factor

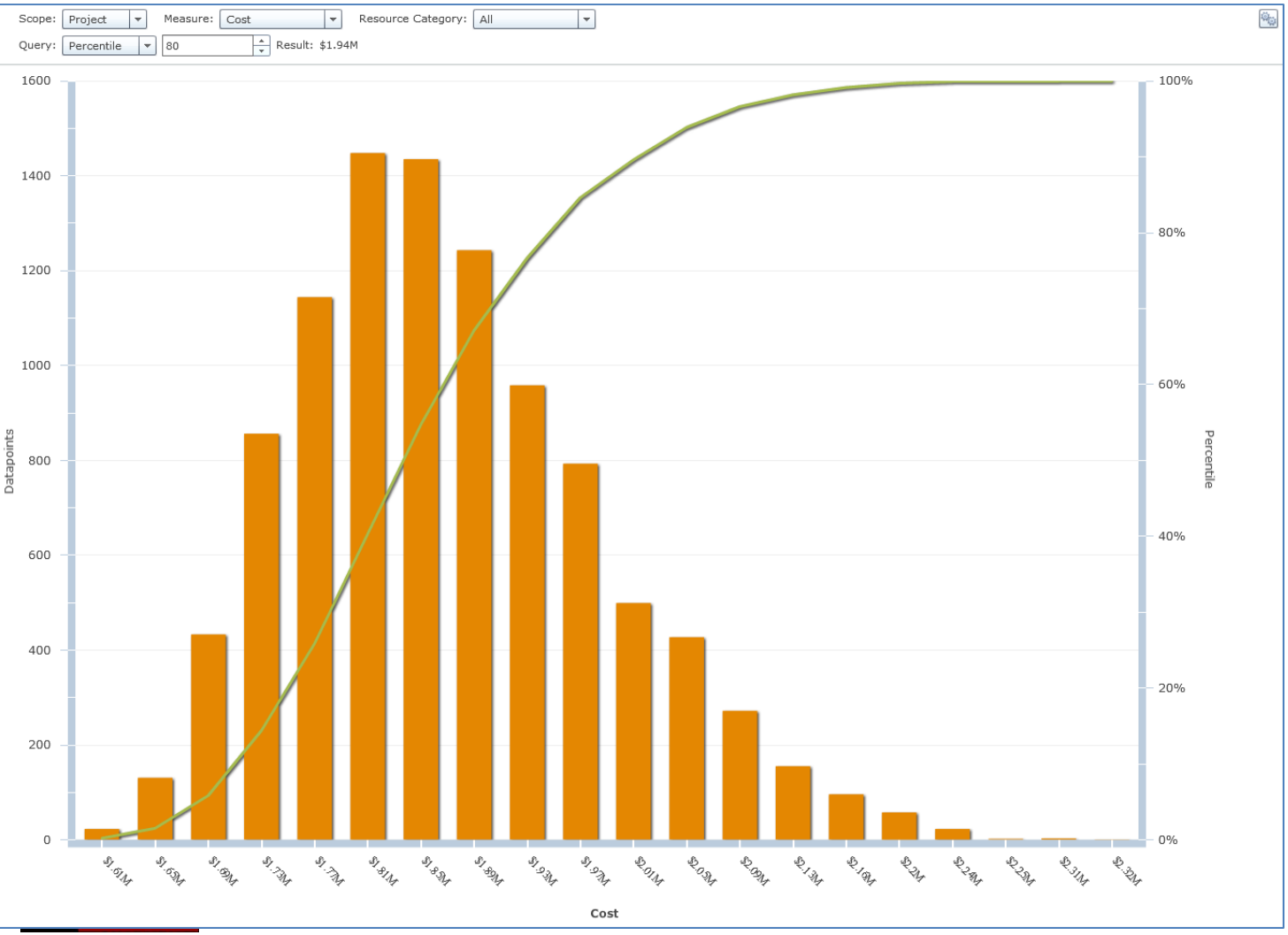
Triangular - Min:0.95 Mode:1.05 Max:1.15

For cost of labor resources there may also be uncertainty on the daily rate, we have used .95 – 1.05 – 1.15 for each.

The Cost Factor generates cost uncertainty independent of the schedule risk

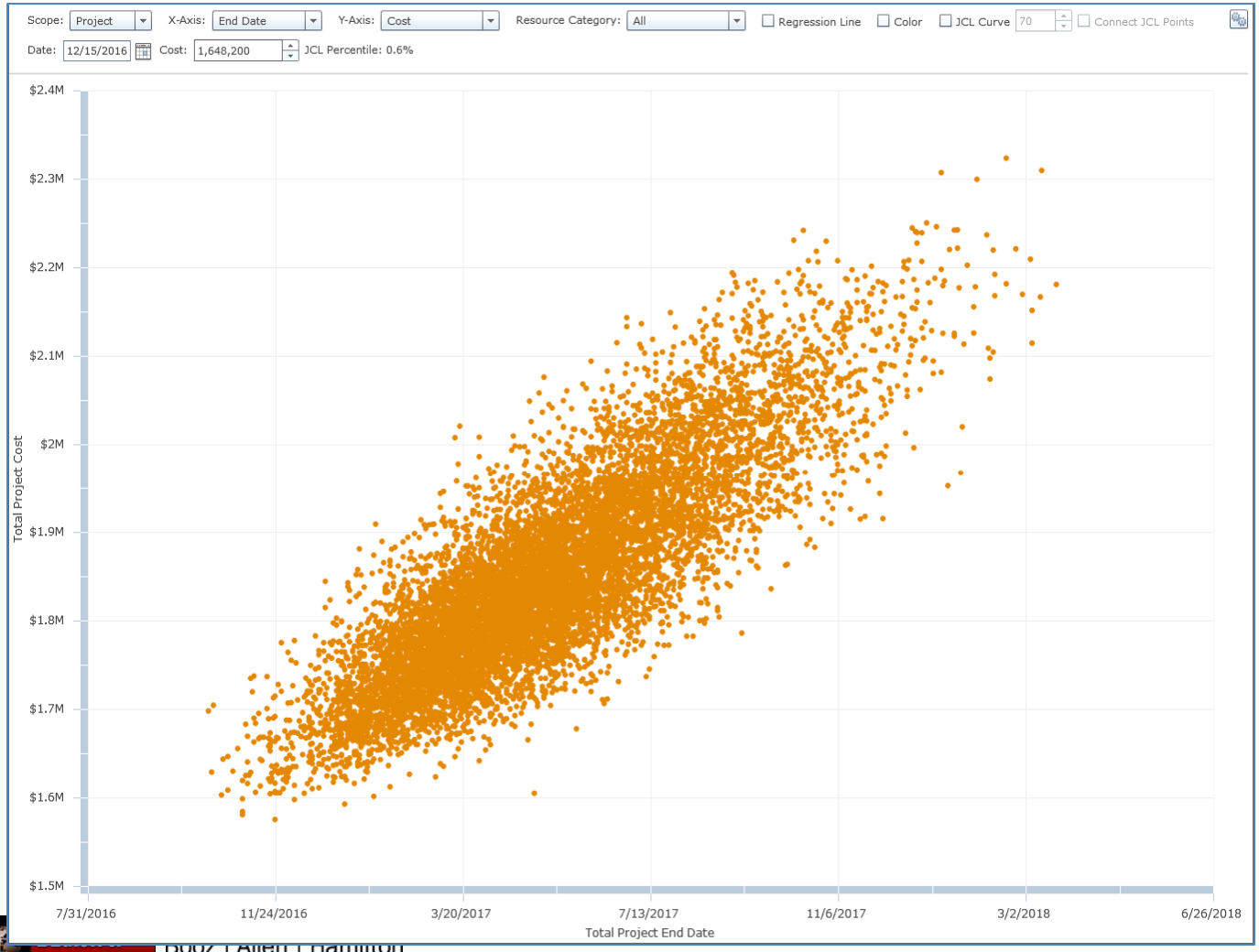
Notice that the “EPC Contractor quality is questionable” is placed on all activities.” Notice the risks are inserted in series, not in parallel.

Cost Risk with Uncertainty added to the Burn Rate of Labor Resources



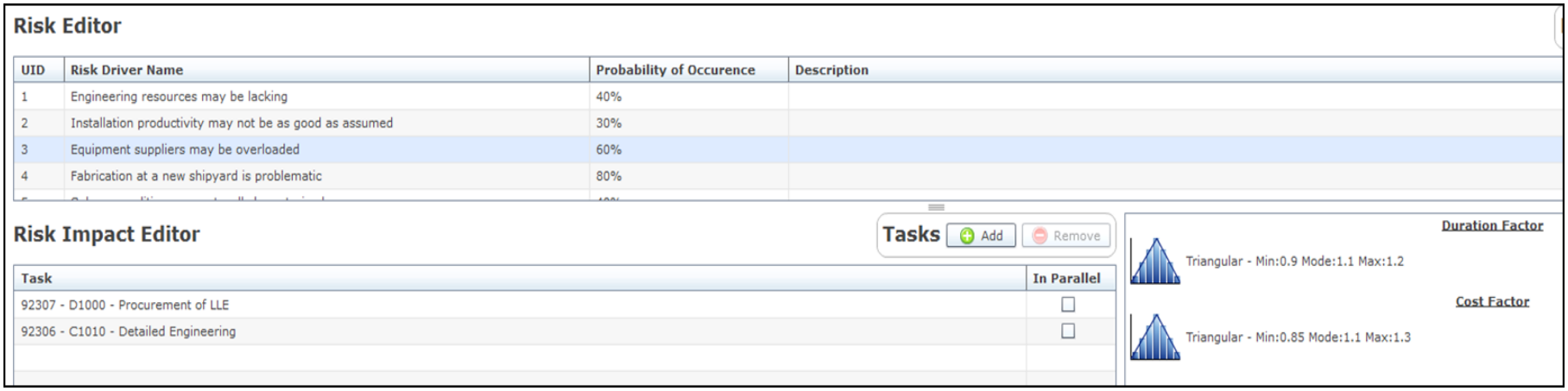
The P-80 for cost is now $1.95 billion

Scatter with uncertainty, schedule and Burn Rate Drivers



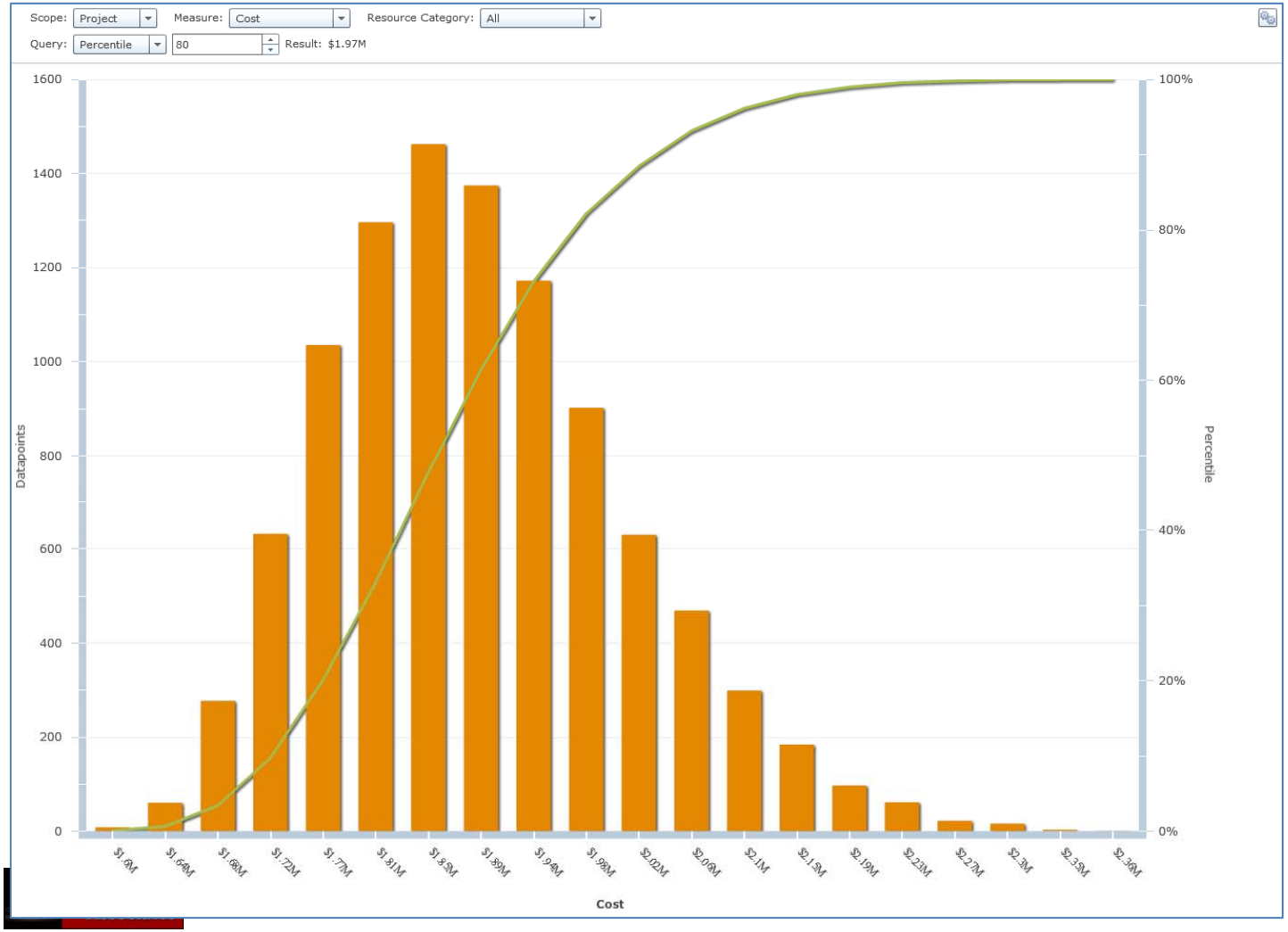
With Uncertainty and risk drivers on schedule and burn rate the correlation between cost and finish date is 84%

Add Uncertainty to Procurement Cost



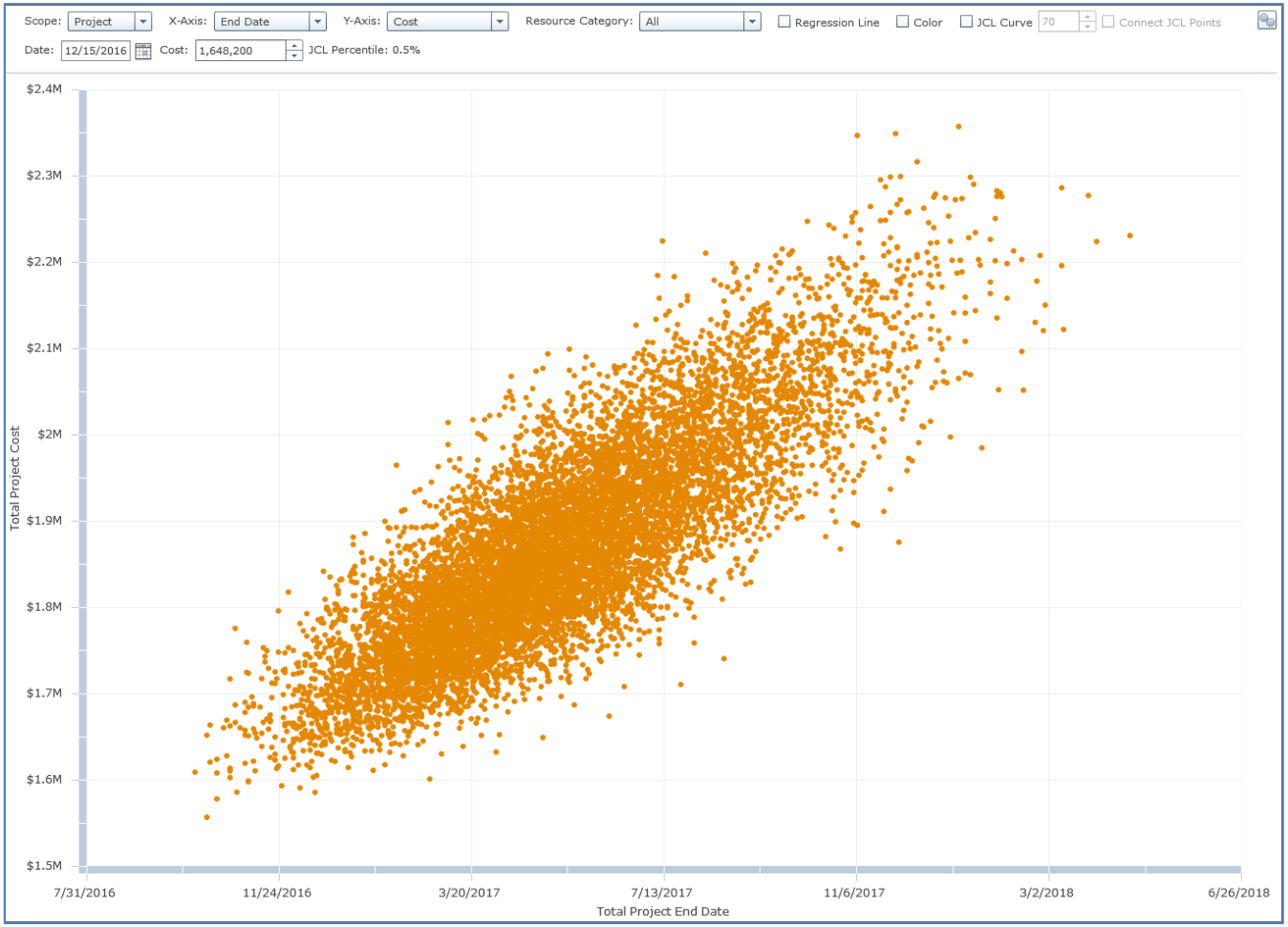
There was schedule risk on Procurement of Equipment but no cost risk since it is a material (time-independent resource).
This action causes cost risk to affect total cost of procured equipment using .85 – 1.1 – 1.3.

Cost Risk with Uncertainty, Schedule Risk Drivers and Cost Risk



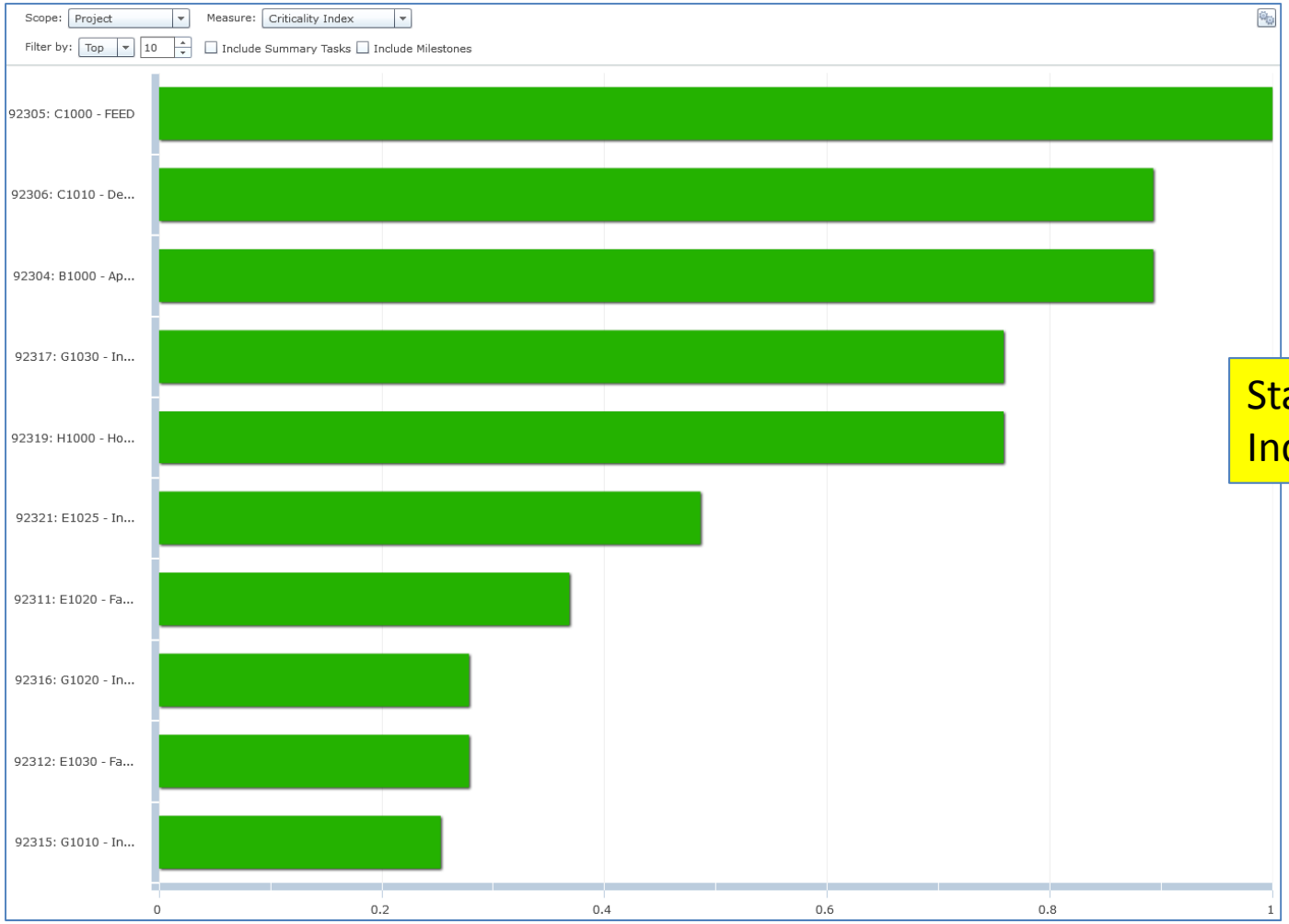
Adding cost risk (burn rate, total procurement) The P-80 increases to $1.97 billion. The schedule risk is unaffected by adding cost risks

Uncertainty, Schedule Risk Drivers and Cost Risk Drivers



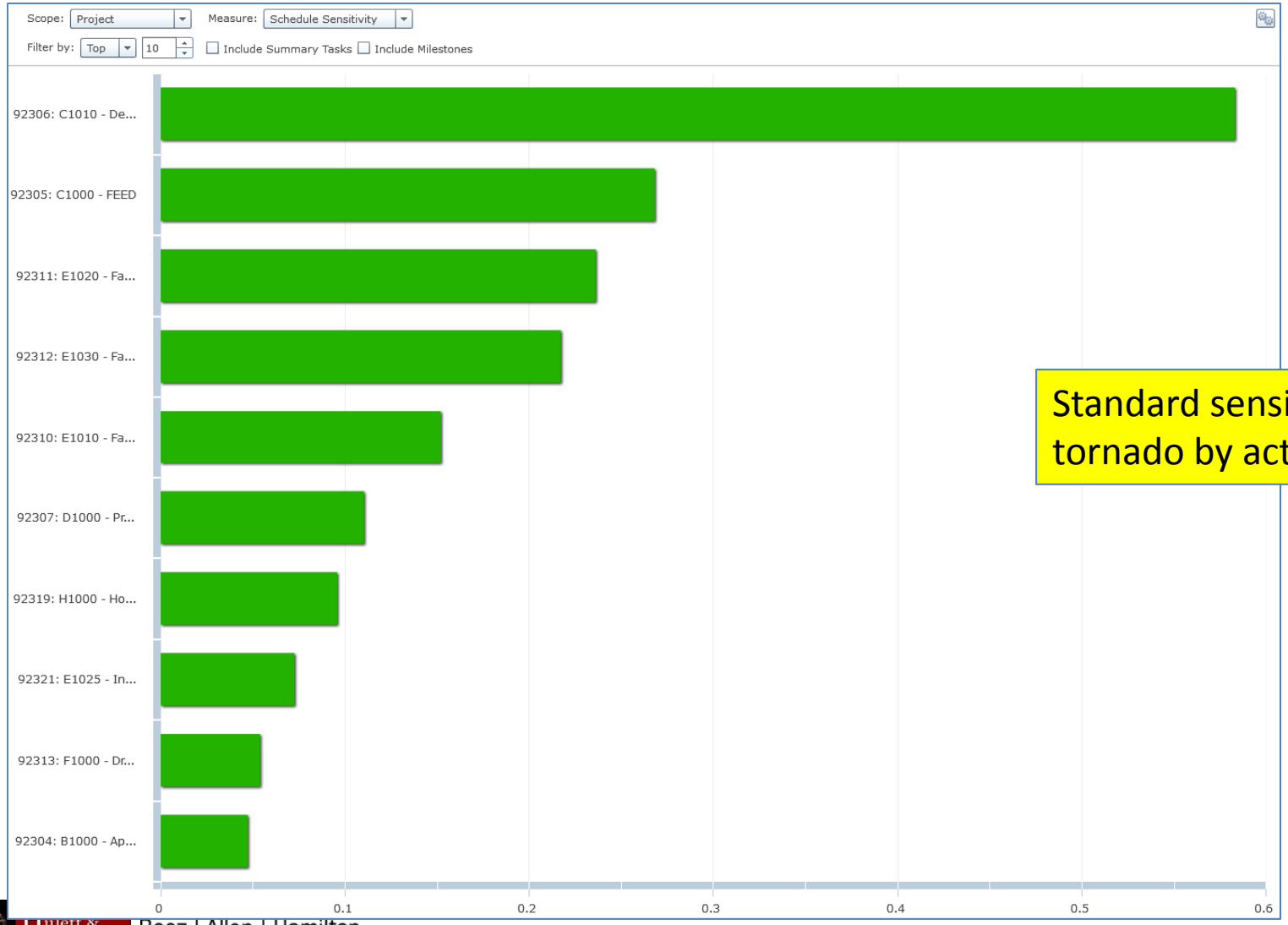
With cost risk added there is more scatter, the link between cost risk and schedule risk is looser – cost risk is greater even if the schedule were perfect.
With cost risk added correlation is 84%

Schedule Criticality Index



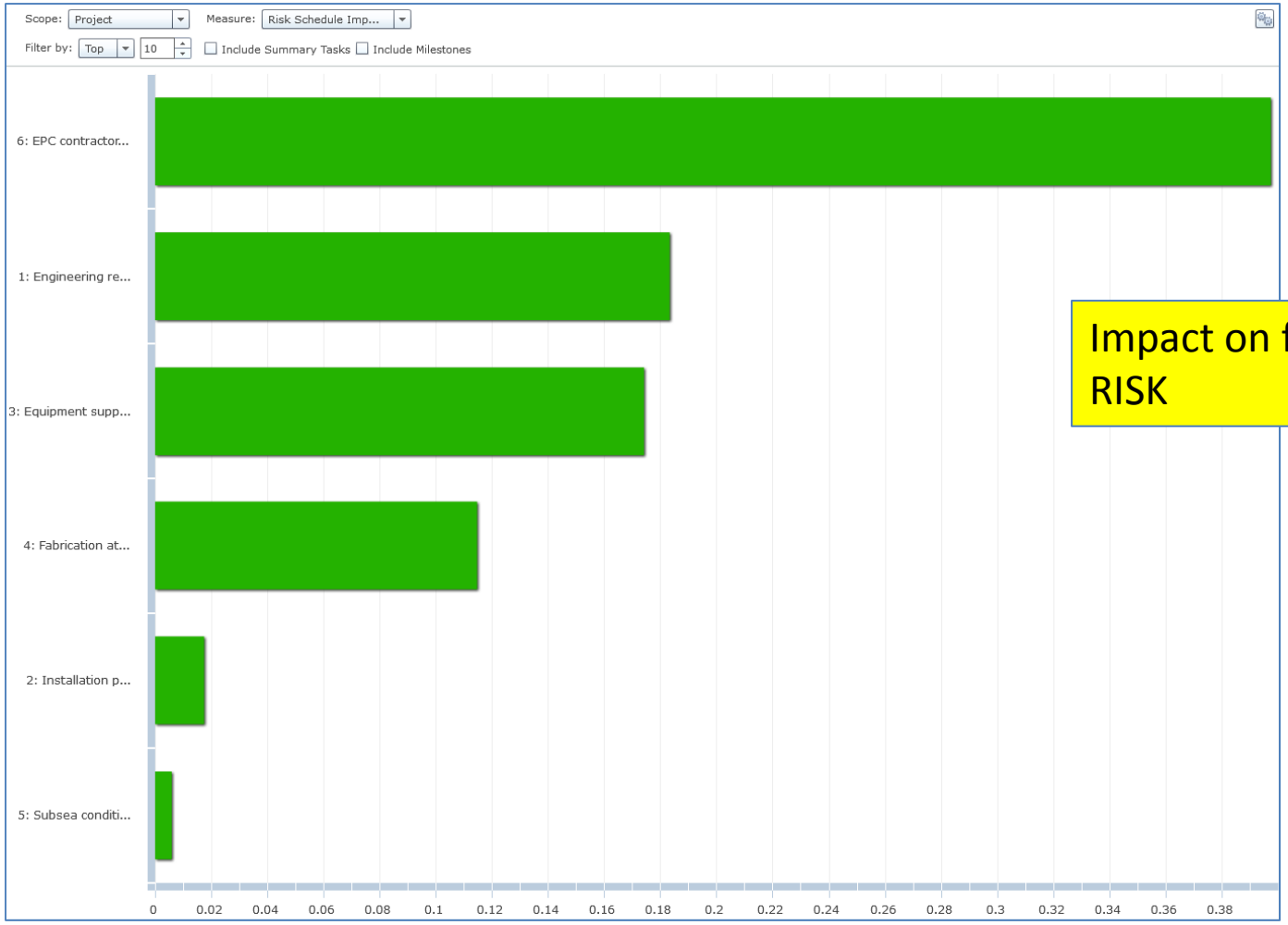
Standard Criticality Index for activities

Schedule Sensitivity by Activity



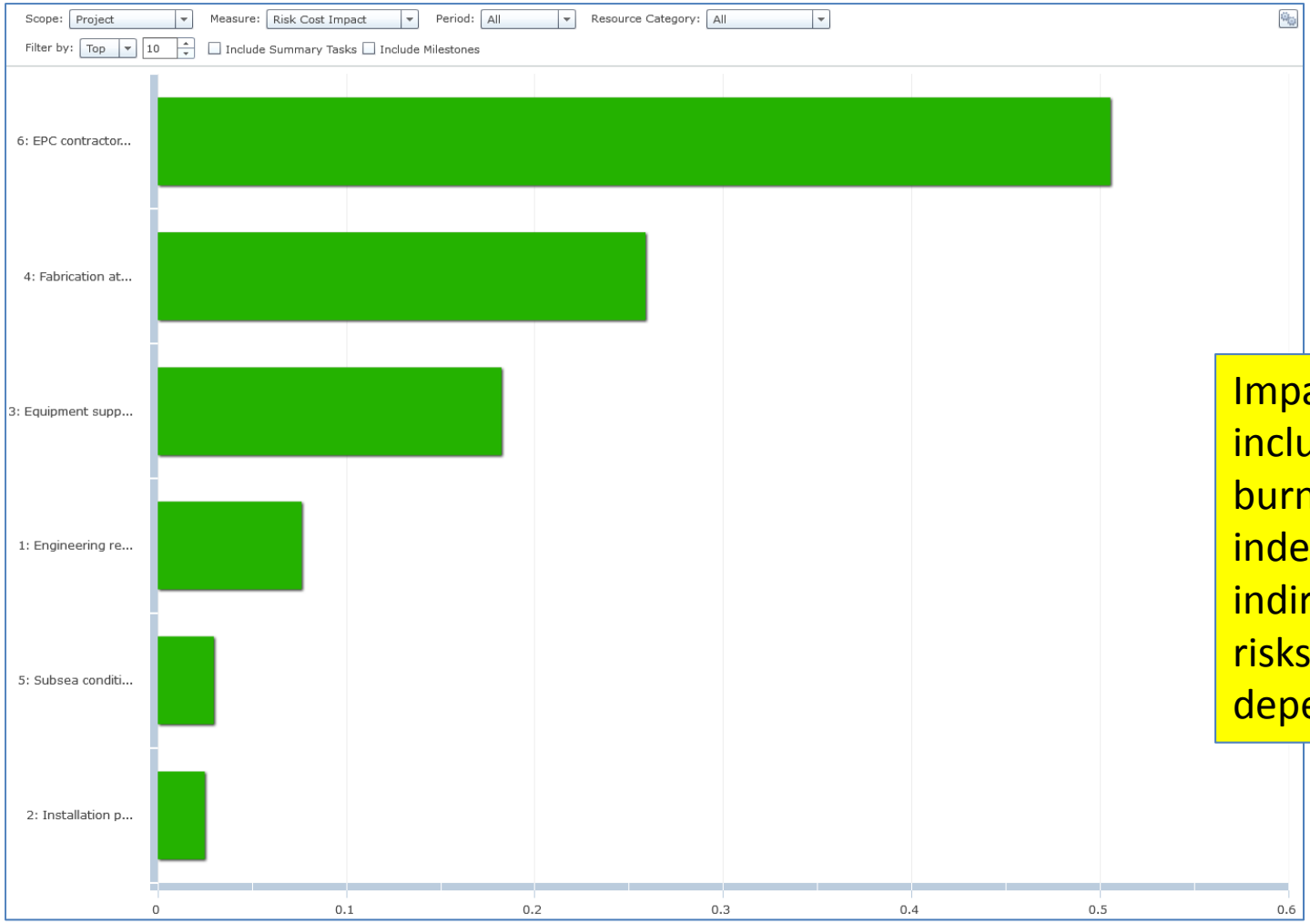
Standard sensitivity tornado by activity

Impact on Schedule by Risk



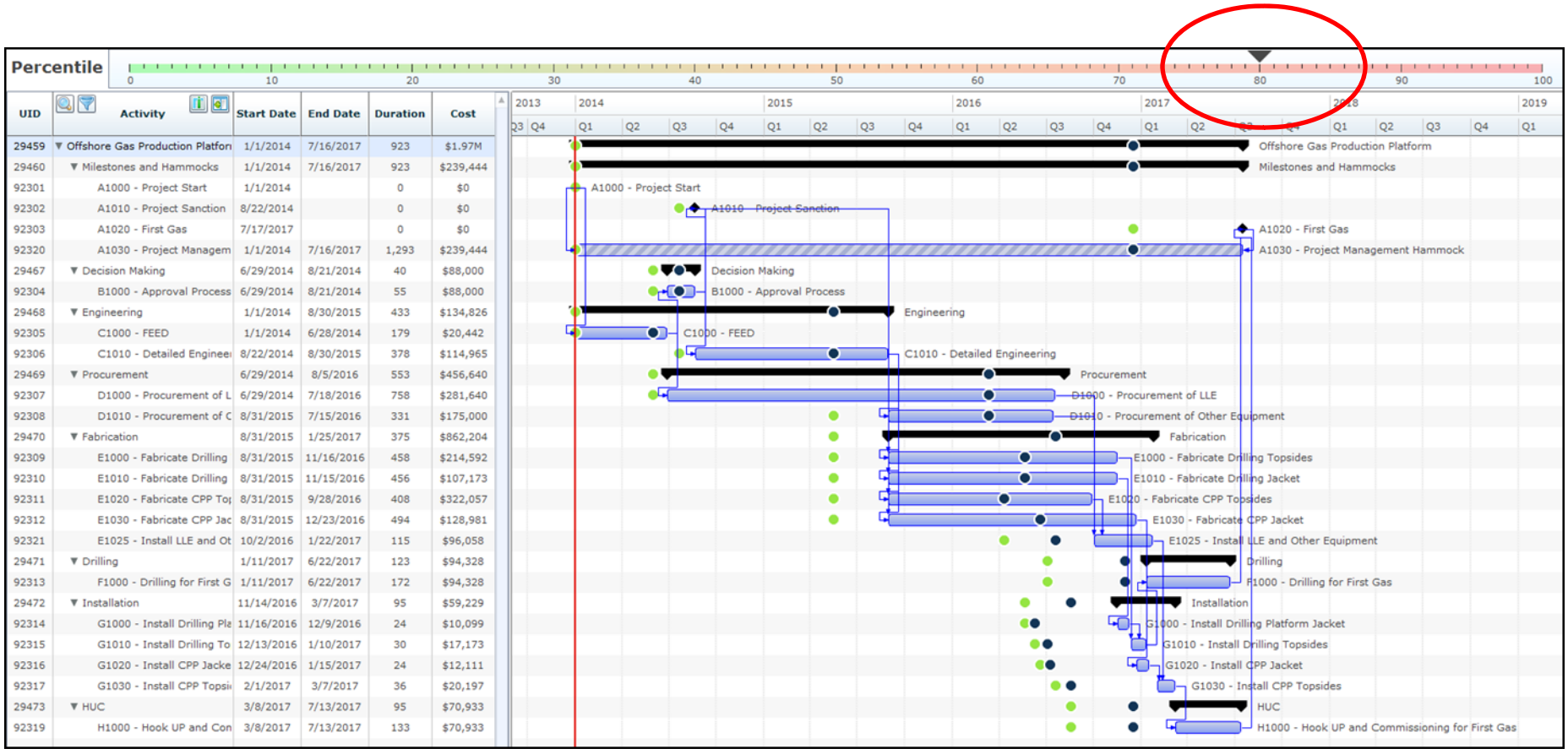
Impact on finish date by RISK

Impact on Cost by Risk



Impact on cost of RISKS, includes direct impact on burn rate and time-independent costs and indirect impact from risks' affecting time-dependent costs

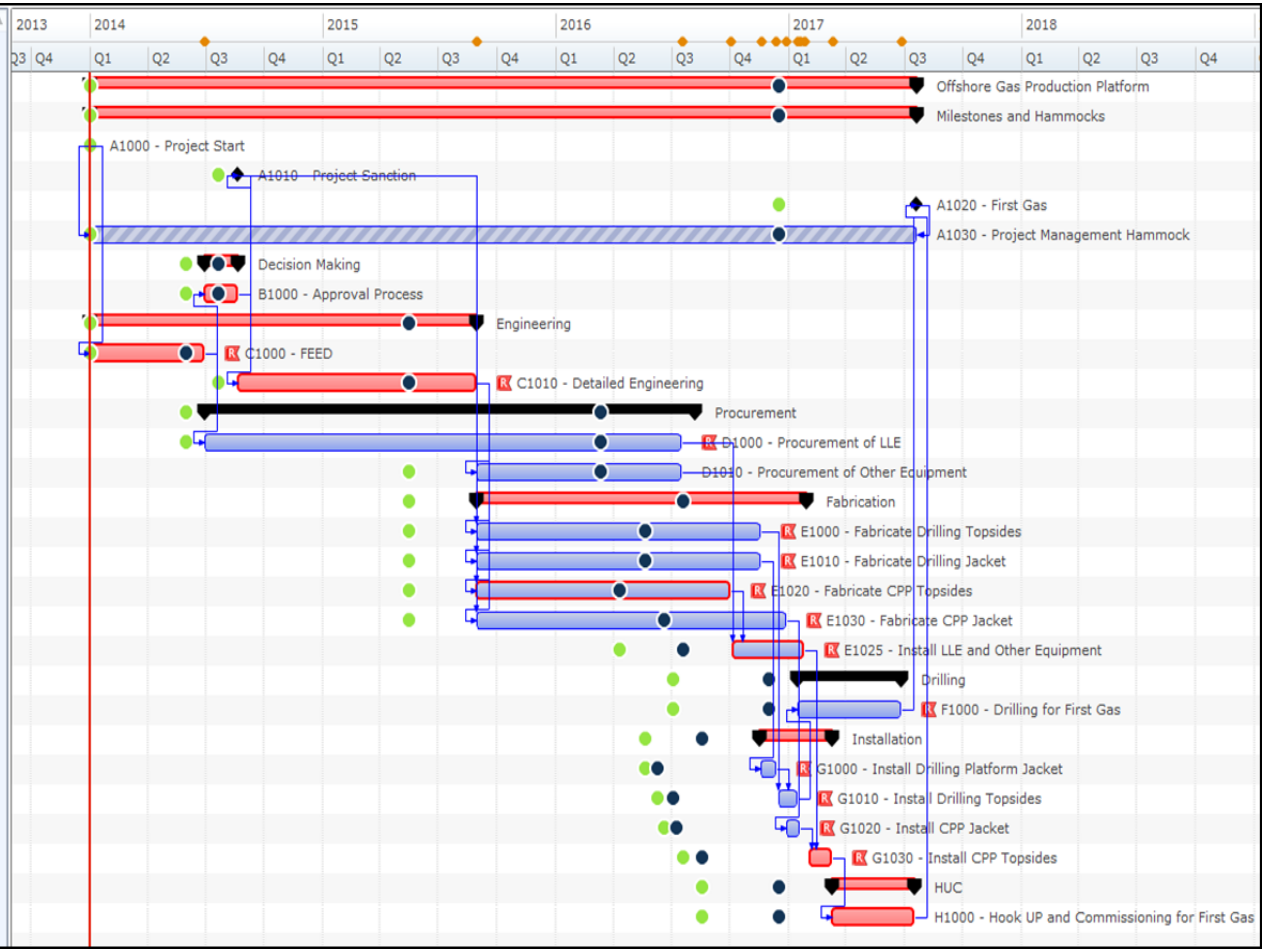
View shows P-80 scenario



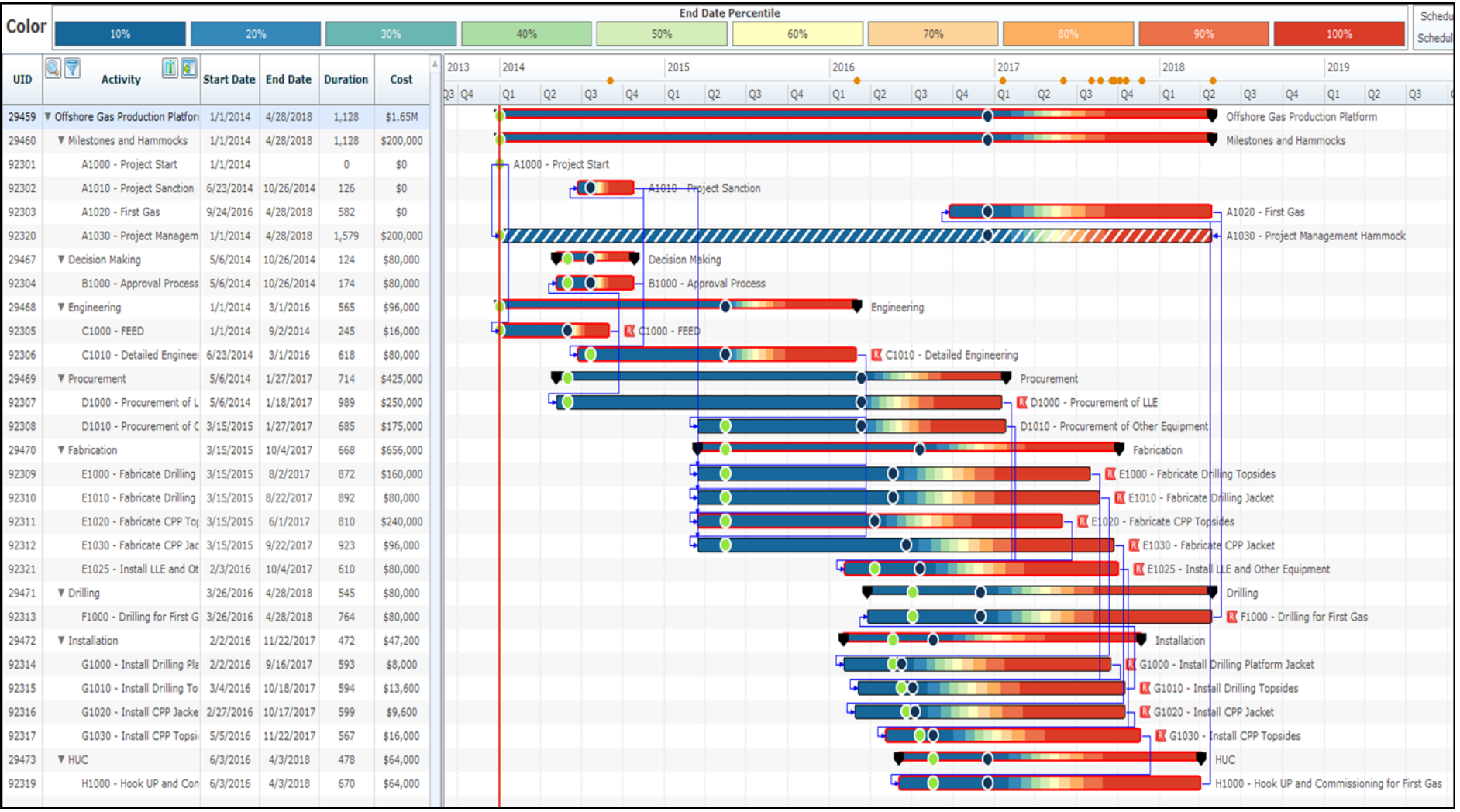
The P-80 results compared to planned start – Green = CPM Starts, Blue = CPM Finishes, Bars = P-80 dates

Where Risks are Assigned, the Planned Critical Path and Risk Criticality

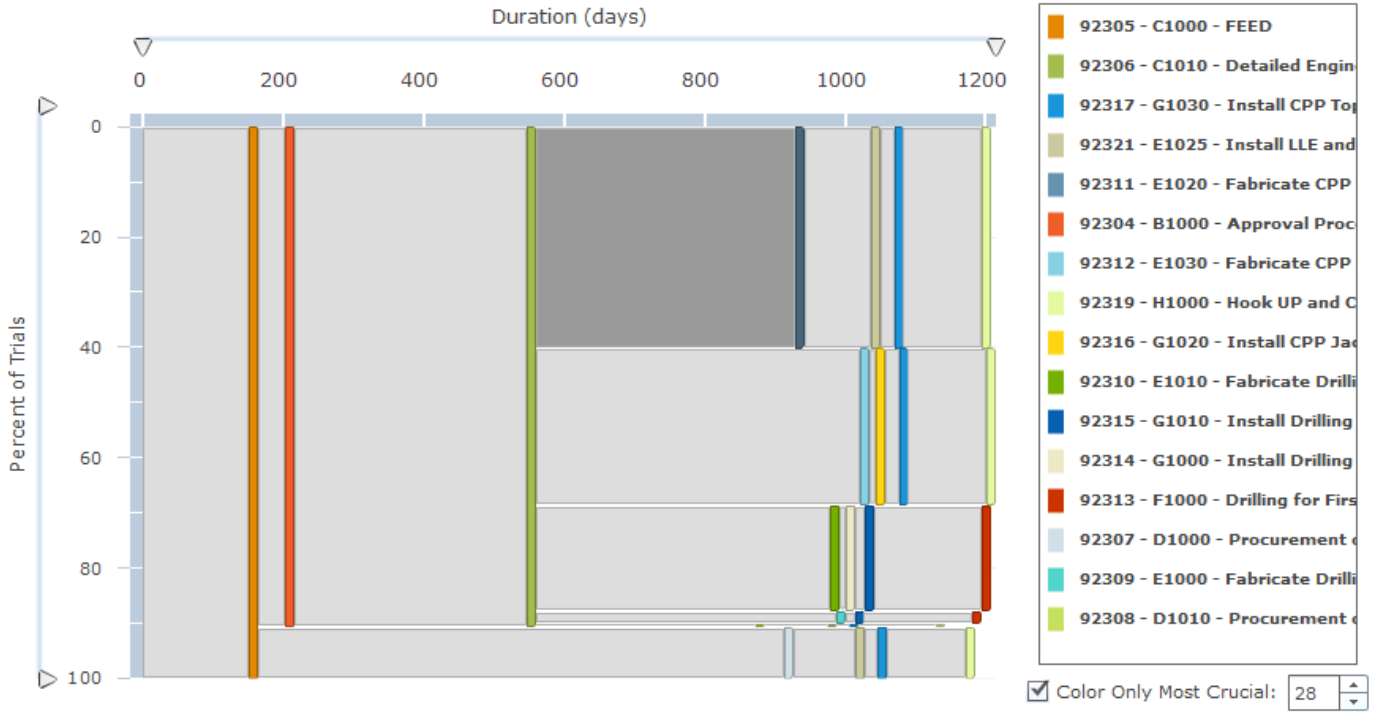
UID	Activity	Start Date	End Date	Duration	Cost
9459	▼ Offshore Gas Production Platfor	1/1/2014	7/20/2017	927	$1.97M
9460	▼ Milestones and Hammocks	1/1/2014	7/20/2017	927	$240,185
2301	A1000 - Project Start	1/1/2014		0	$0
2302	A1010 - Project Sanction	8/22/2014		0	$0
2303	A1020 - First Gas	7/21/2017		0	$0
2320	A1030 - Project Managem	1/1/2014	7/20/2017	1,297	$240,185
9467	▼ Decision Making	6/30/2014	8/21/2014	40	$88,000
2304	B1000 - Approval Process	6/30/2014	8/21/2014	55	$88,000
9468	▼ Engineering	1/1/2014	8/30/2015	433	$135,148
2305	C1000 - FEED	1/1/2014	6/29/2014	180	$20,511
2306	C1010 - Detailed Enginee	8/22/2014	8/30/2015	378	$115,211
9469	▼ Procurement	6/30/2014	8/6/2016	553	$456,514
2307	D1000 - Procurement of L	6/30/2014	7/17/2016	759	$281,514
2308	D1010 - Procurement of C	8/31/2015	7/17/2016	331	$175,000
9470	▼ Fabrication	8/31/2015	1/28/2017	376	$864,702
2309	E1000 - Fabricate Drilling	8/31/2015	11/18/2016	459	$215,296
2310	E1010 - Fabricate Drilling	8/31/2015	11/18/2016	458	$107,571
2311	E1020 - Fabricate CPP Top	8/31/2015	10/1/2016	409	$322,950
2312	E1030 - Fabricate CPP Jac	8/31/2015	12/27/2016	496	$129,314
2321	E1025 - Install LLE and Ot	10/6/2016	1/25/2017	116	$96,402
9471	▼ Drilling	1/15/2017	6/26/2017	122	$94,232
2313	F1000 - Drilling for First G	1/15/2017	6/26/2017	171	$94,232
9472	▼ Installation	11/17/2016	3/10/2017	95	$59,255
2314	G1000 - Install Drilling Pla	11/19/2016	12/11/2016	24	$10,108
2315	G1010 - Install Drilling To	12/17/2016	1/14/2017	30	$17,171
2316	G1020 - Install CPP Jacke	12/28/2016	1/18/2017	24	$12,129
2317	G1030 - Install CPP Topsi	2/4/2017	3/10/2017	36	$20,227
9473	▼ HUC	3/11/2017	7/16/2017	95	$70,933
2319	H1000 - Hook UP and Con	3/11/2017	7/16/2017	133	$70,933



Color shows Percentile Dates



Reviewing Critical Path Tree



Selected Task: 92311 - E1020 - Fabricate CPP Topsides

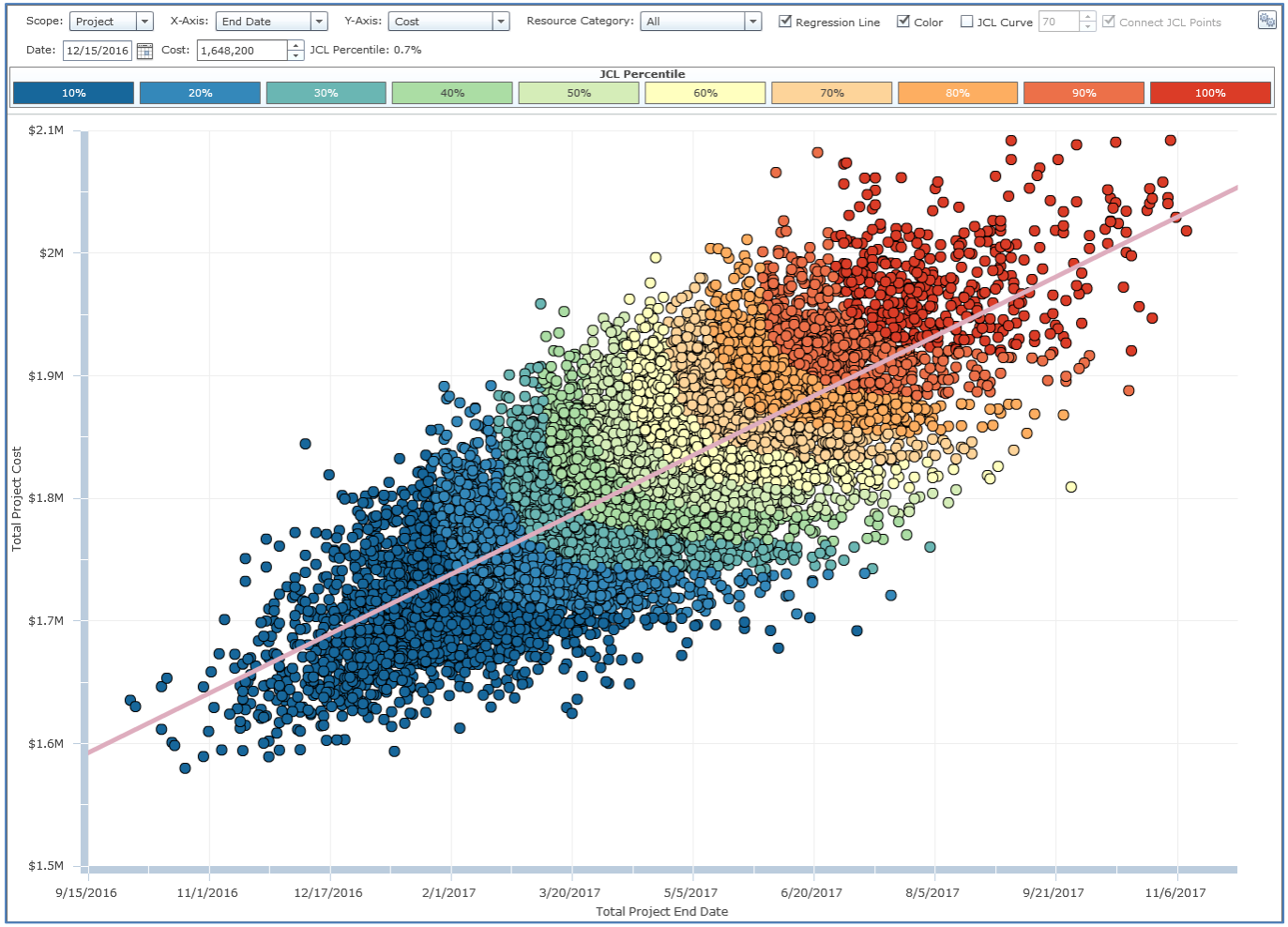
Preceding Tasks	Avg Duration
92305 - C1000 - FEED	165
92304 - B1000 - Approval Process	52
92306 - C1010 - Detailed Engineering	343
92311 - E1020 - Fabricate CPP Topsides	382

Risks

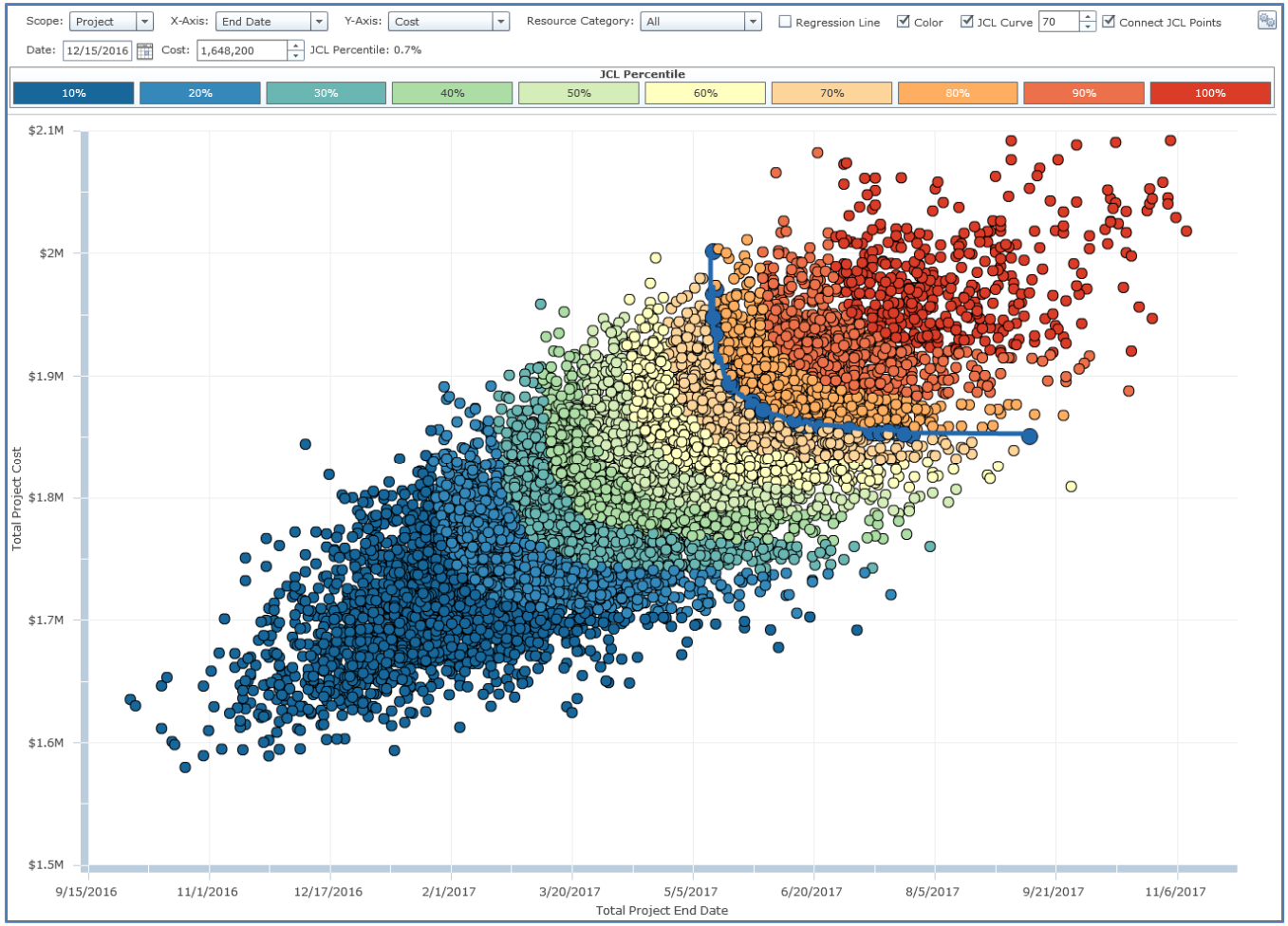
Risk Drivers
4 - Fabrication at a new shipyard is
6 - EPC contractor quality is questio

Analysis shows project has three, parallel, critical paths – potentially creating a risk for significant schedule growth

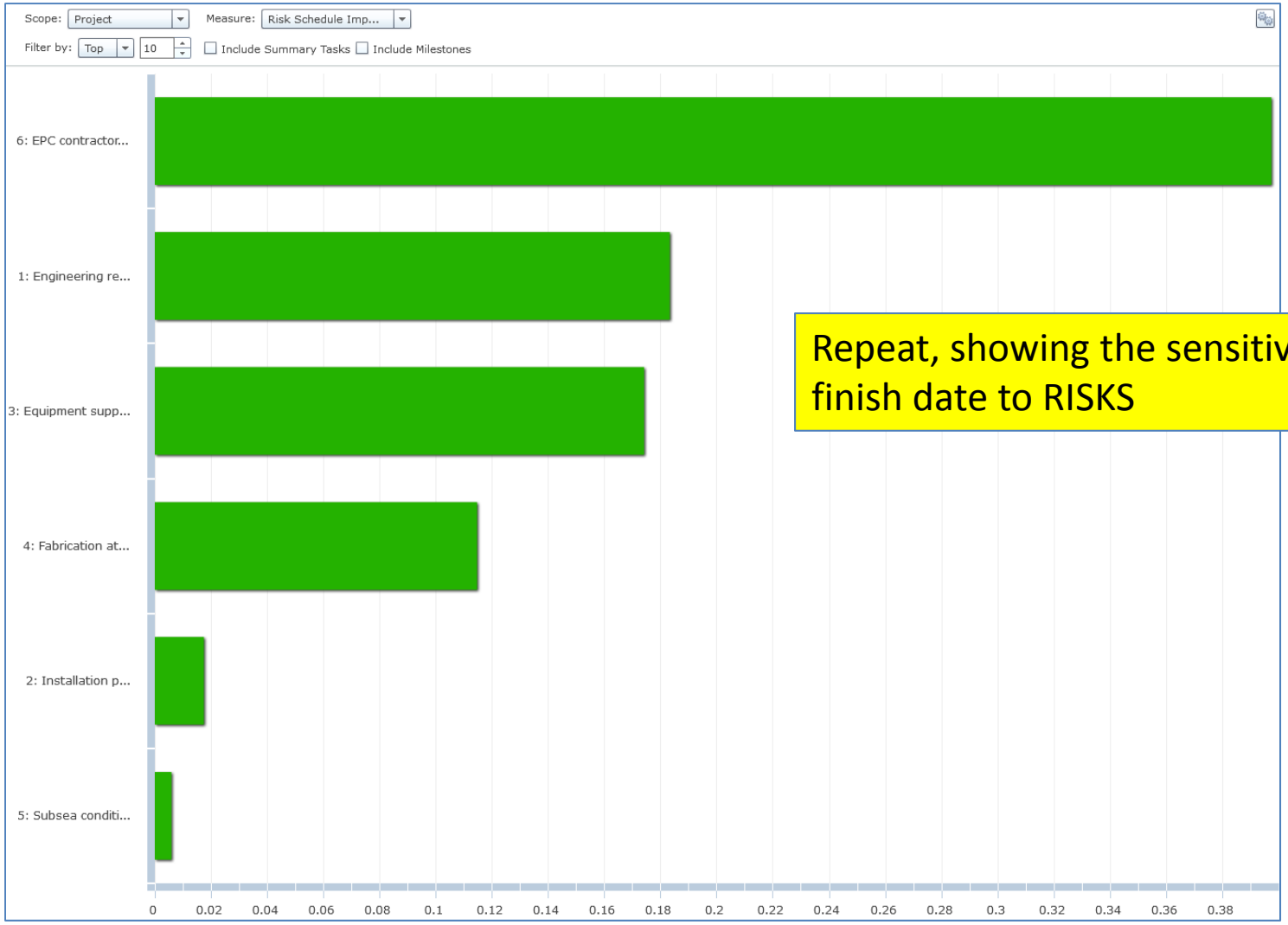
Scatter Plot with Trend Line and Color to Show Percentiles



Joint Cost-Time Confidence Level (JCL) at the 70th percentile as used by NASA



Prioritize Risks Using Tornado Chart



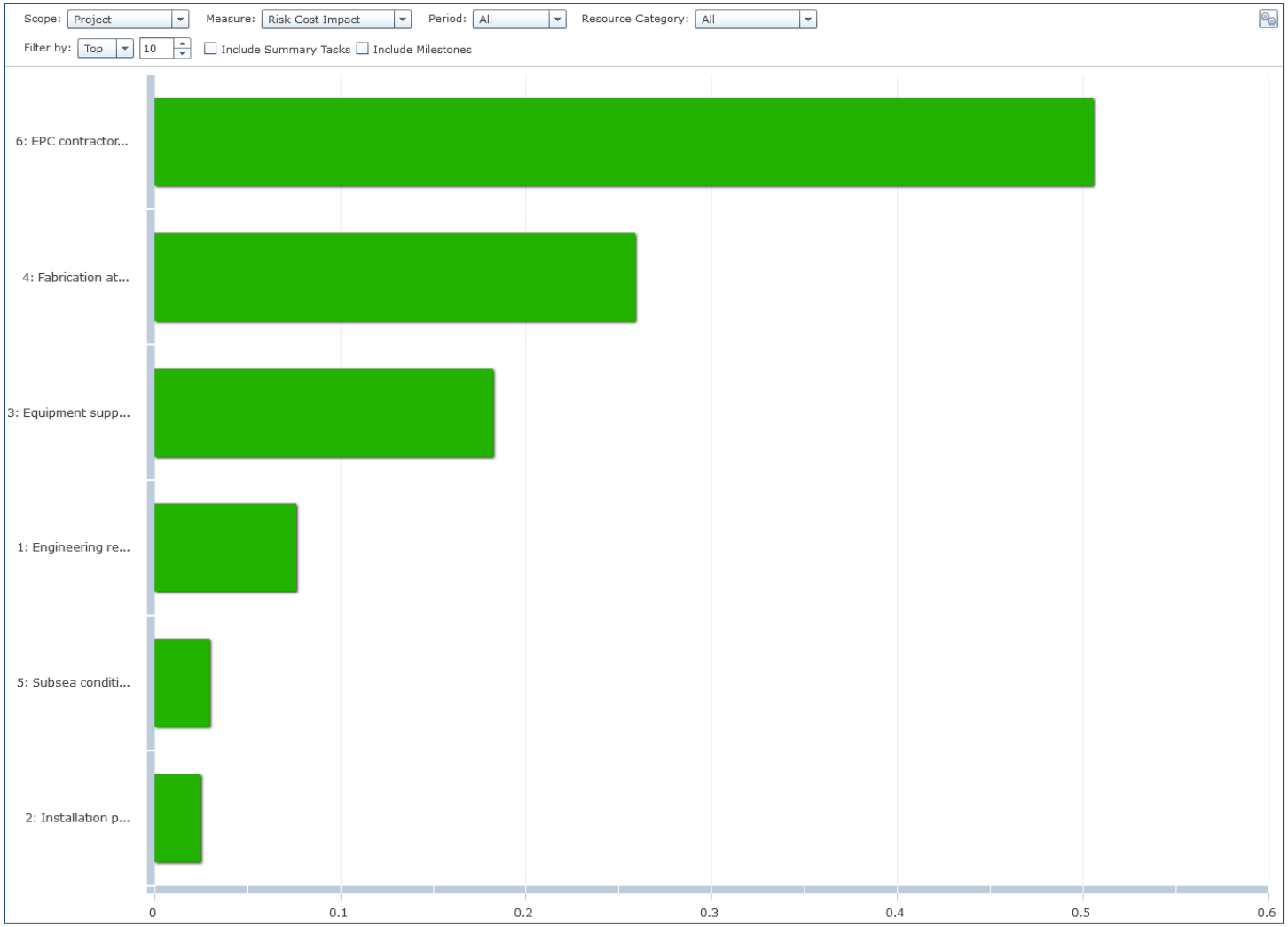
Repeat, showing the sensitivity of finish date to RISKS

Prioritizing Risk Drivers to Finish First Gas at P-80

Prioritized Risks to Schedule			
	Baseline Date	16-Dec-16	
		P-80 Date	
	All Risks Included	21-Jul-17	Calendar Days Saved
Risk ID	Risk Name		
6	EPC contractor quality is questionable	31-May-17	51
4	Fabrication at a new shipyard is problematic	9-May-17	22
3	Equipment suppliers may be overloaded	15-Apr-17	24
1	Engineering resources may be lacking	30-Mar-17	16
2	Installation productivity may not be as good as assumed	28-Mar-17	2
5	Subsea Conditions are not well characterized		
	Inherent uncertainty and duration estimation error	16-Dec-16	102

Risk Tornado risk order is: 6 – 1 – 3 – 4 – 2 – 5
This priority order is: 6 – 4 – 3 – 1 – (2-5)

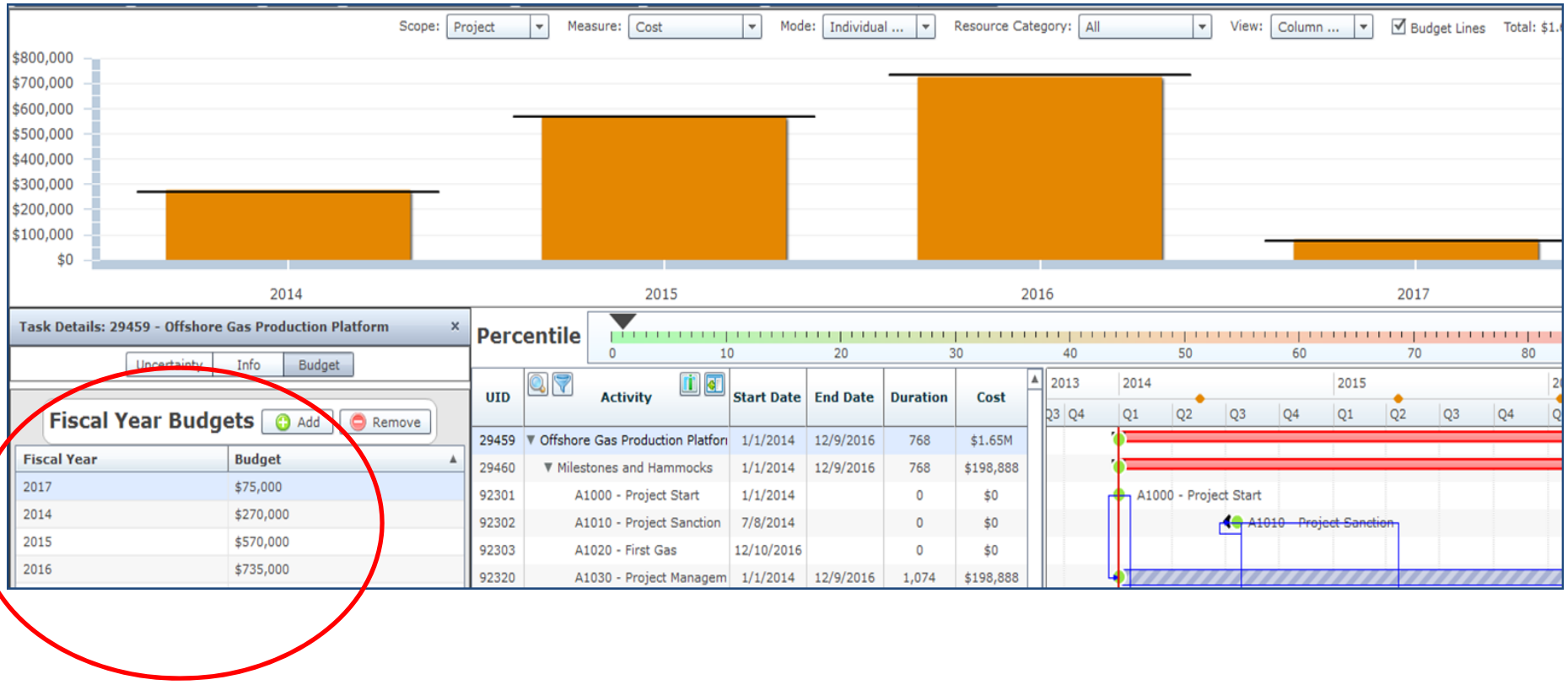
Prioritizing Risk Drivers to Cost



Prioritizing Risk Drivers to Cost at P-80

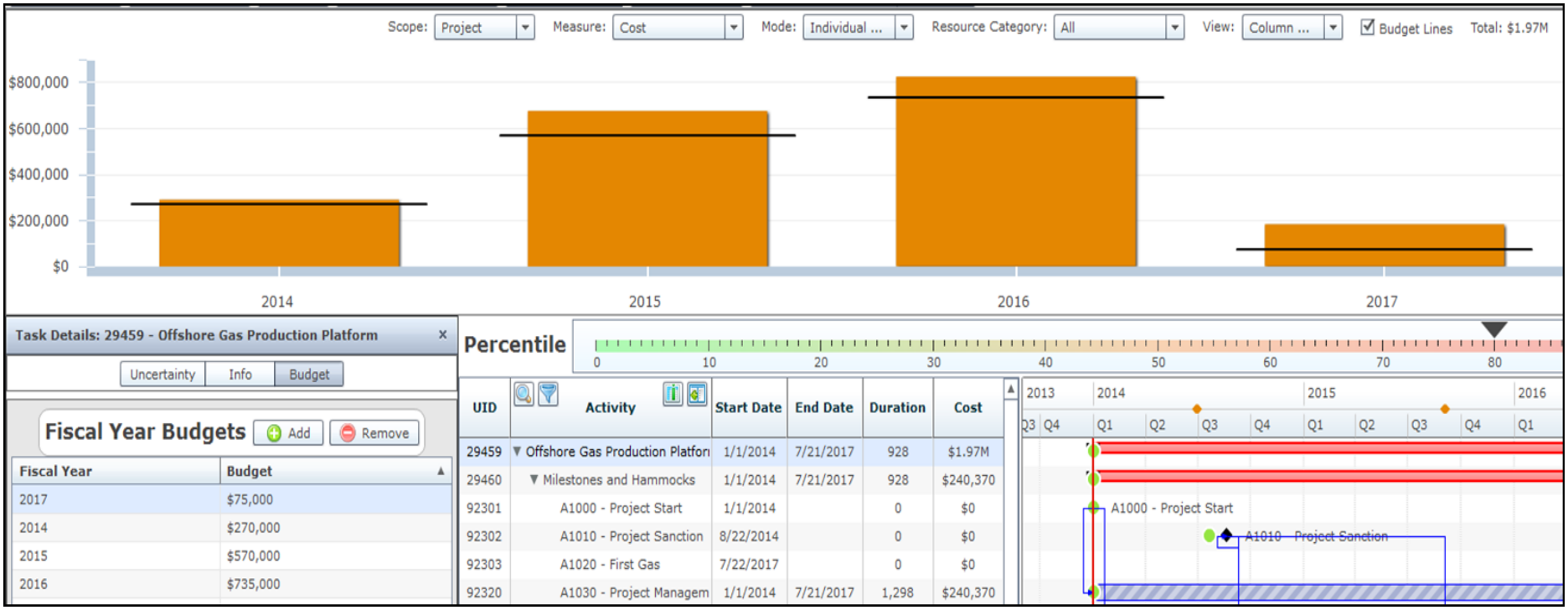
Prioritized Risks to Cost			
	Baseline Cost	1.65	
		P-80 Cost	
	All Risks Included	1.97	$ millions saved
Risk ID	Risk Name		
6	EPC contractor quality is questionable	1.88	0.09
4	Fabrication at a new shipyard is problematic	1.80	0.08
3	Equipment suppliers may be overloaded	1.77	0.03
1	Engineering resources may be lacking	1.76	0.01
2	Installation productivity may not be as good as assumed	1.75	0.01
5	Subsea Conditions are not well characterized		
	Inherent uncertainty and duration estimation error	1.65	0.10

Compare to the Annual Budget



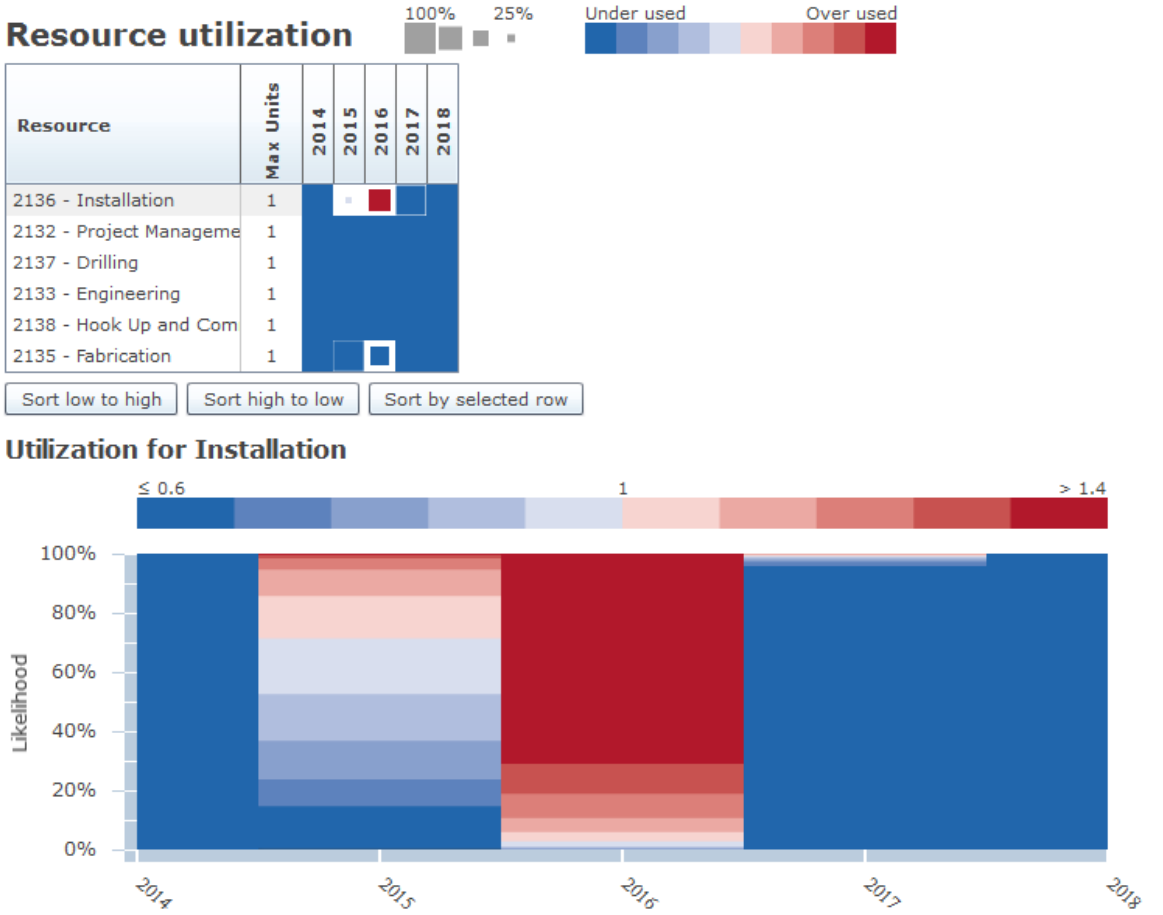
This view shows that the $ 1.65 billion is OK only at the 1st percentile

Setting the Percentile to the 80th



This analysis shows where the project will overrun its annual budget if it's total finish schedule is set at the P-80

Reviewing Resource Utilizations



This analysis shows the project's installation resources are over utilized in 2016

Project Schedule and Cost Risk Analysis using Polaris®

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