



Training Institute
CRITICAL THINKING.
SOLUTIONS DELIVERED.

Connecting the Dots:

An approach to integrating program risks with the POE

2015 ICEAA conference

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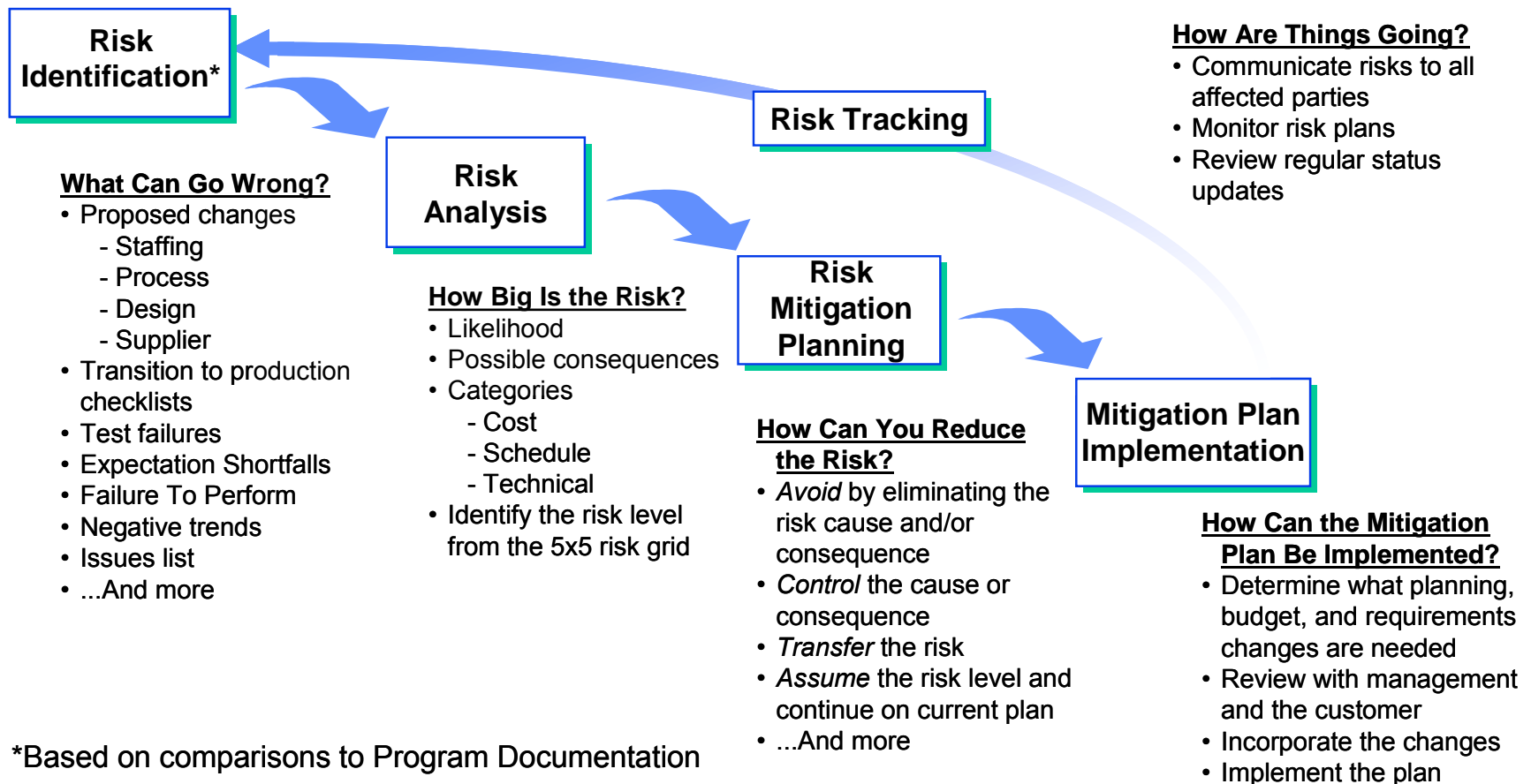
Overview

- Introduction
- Risk Management Process
- Example Risk Matrix
- Problems associated with Risk Matrix method
- Risk example
- Proposed step-wise process
- Future applications

Introduction

- Smaller programs (ACAT III and below) do not always have a full-time cost analyst
- Decision makers need quick feedback into the impact of new program risks
- The program office estimate (POE) should include risks identified in the risk matrix
- The risk matrix needs the POE to identify risk consequences
- We need to train IPTs to effectively quantify risks
- Can be use to conduct sensitivity analysis to program risks
- Can be used to identify worst-case scenario acquisition cost
- Concept can be applied to the opportunity matrix for should cost analysis

Risk Management Process

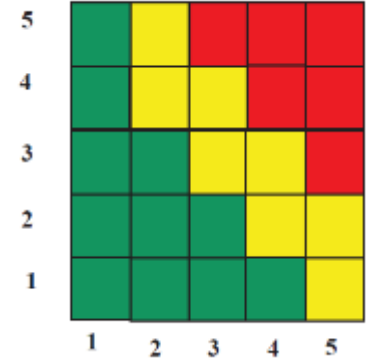


*Based on comparisons to Program Documentation

Example Risk Matrix

Likelihood (y)

Level	Likelihood	Probability of Occurrence
1	Not Likely	~10%
2	Low Likelihood	~30%
3	Likely	~50%
4	Highly Likely	~70%
5	Near Certainty	~90%



Consequence (x)

Level	Technical Performance *	Schedule	Cost
1	Minimal or no consequence to technical performance	Minimal or no impact To schedule	Minimal or no impact
2	Minor reduction in technical performance or supportability, can be tolerated with little or no impact on program ; same approach retained	Additional activities required, able to meet key dates. Slip < 1 month from baseline.	Budget increase or unit production cost increases ≤ (1% of Budget)
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4	Significant degradation in technical performance or major shortfall in supportability; may jeopardize program success; workarounds may not be available or may have negative consequences	Program critical path affected, all schedule float associated with key milestone exhausted. Slip < 6 months from baseline	Budget increase or unit production cost increase ≤ (10% of Budget)
5	Severe degradation in technical performance; Cannot meet KPP or Key technical/supportability threshold; will jeopardize program success; no workarounds available	Cannot meet key program milestones. Slip > 6 months from baseline	Exceeds APBA threshold ≥ (10% of Budget)

Problems with the Risk Cube Method

Taken from Module 9 CEBok

- Risk Cubes do add value
 - They are intuitive to engineers
 - Connect with risk management processes

- But, we expect Risk Cube results to be lower than historical cost growth results suggest
 - Be skeptical of the risk register
 - Identification and scoring by SMEs makes bias likely
 - Any method that relies upon Experts, especially Proposal Team Experts, will tend to be low

Risk example

Performance of a computer battery used by 100 students.

Forty of the batteries lasted 2.5 hours, 25 batteries lasted 3 hours, 20 batteries lasted 2 hours, 10 batteries lasted 1.5 hours, and five batteries lasted 3.5 hours.

Complete the statement - "It is improbable/unlikely that the battery will last _____ hours"

We're bad at estimating risk

60% of participants answered 4 hours despite the fact that 0 of the 100 batteries lasted that long.

The same kind of result occurred in a variety of similar experiments, thereby suggesting that things deemed improbable or unlikely are frequently interpreted as having close to a 0% chance of occurring¹

¹ [Teigan, Karl](#)

Proposed solution

- Train IPT teams to understand what is meant by “unlikely”
- Introduce a step-wise process to elicit triangular distributions to quantify the cost consequences of risk
- Use the risk distributions to select the consequence of the risk
- Update the WBS element to include the new risk distribution

Example Risk

- Be sure risks are clearly defined
 - *Risk Title: Lack of Product Reliability Demonstration*
 - *Root Cause: If Mean Time Between Failure Design Controllable requirement of 2,000 hours for Product is not demonstrated, then the Fleet could see high rate of failure with a subsequent increase in Fleet O&S costs.*
 - *Description of Risk: Rain test in the test plan and test report does not contain a specified duration or defined time period for the post test functional check. The rain test was conducted at MET Labs and the post test functional check was conducted at Vendor. During the Delta Fleet Assessment one of the Product microphones failed while being used in the rain. Vendor's fault analysis did not provide any information about the root cause. Given the short duration of the Fleet Assessment and the limited number of Product, this failure indicates a very low MTBF.*
 - *Consequence if Risk is realized: Performance requirement not met. The microphone assembly costs about \$1,200 to replace. Low MTBF and high replacement cost will impact Fleet budgets.*

Example Risk

Lack of Product Reliability Demonstration



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1	Not Likely	~10%
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Example Risk cont

Determine what was the baseline used in the original POE. How often were the microphones planned on being replaced?

- *Assumed at any given point 60% of the products were in use, 316 days a year, 13.6 hours per day ($.6 * 316 * 13.6 = 2,578$ hours per year per unit) and a logistician estimated MTBF of 10,000 hours (remember vendor required 2,000 hours)*
- *POE assumed units would need to be replaced once every 4 years*
- *5,000 total units procured*
- *Average annual cost of \$1.5M to replace microphone*

Assess the new risk

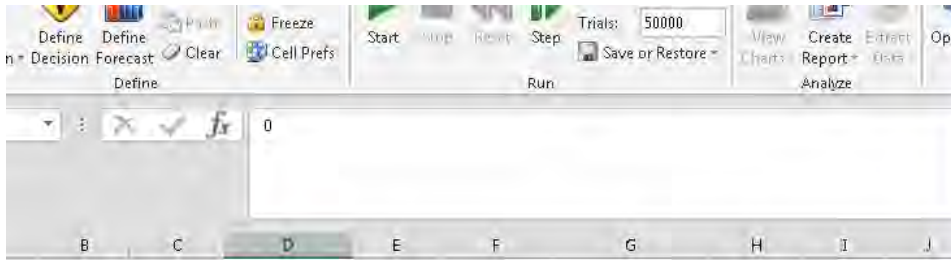
Propose using the “Greenberg method”

1. What probability would you assign to a value that's "Very Unlikely"?
What probability would you assign to a value that's "Extremely Unlikely"?

Extremely Likely	Extremely Unlikely	Very Likely	Very Unlikely
95%	5%	75%	25%
96%	4%	80%	20%
97%	3%	85%	15%
98%	2%	90%	10%
99%	1%	95%	5%

Descriptor	Description	Probability
Absolutely Impossible	No possibility of occurrence	0%
Extremely Unlikely	Nearly impossible to occur	5%
Very Unlikely	Highly unlikely to occur; not common	20%
Somewhat Unlikely	Indifferent between "Very Unlikely" & "Even chance"	35%
Even Chance	50/50 chance of being higher or lower	50%
Somewhat Likely	Indifferent between "Very Likely" & "Even chance"	65%
Very Likely	Highly likely to occur; common occurrence	80%
Extremely Likely	Nearly certain to occur	95%
Absolutely Certain	100% Likelihood	100%

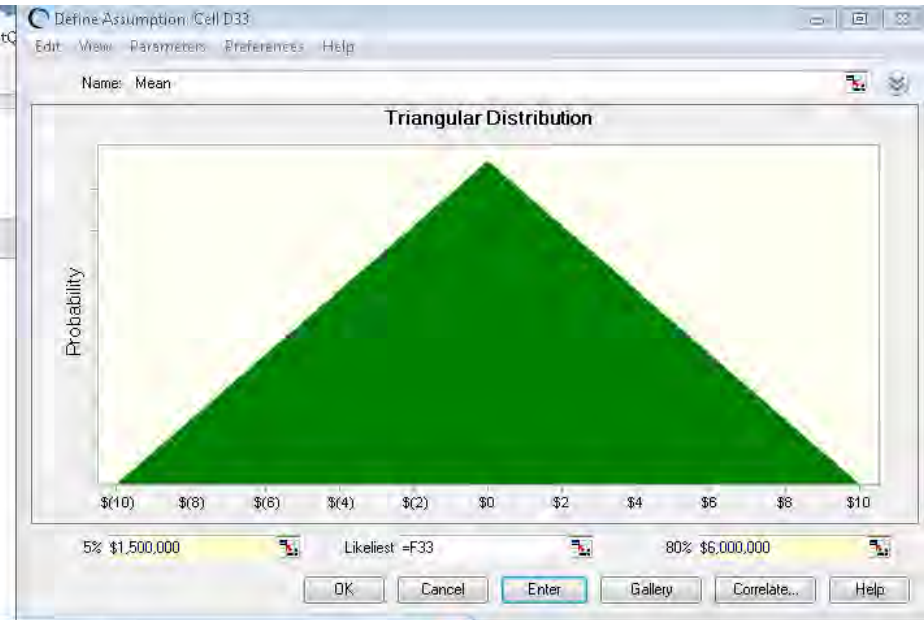
Assess the new risk



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Very Likely	Highly likely to occur; common occurrence	80%
Extremely Likely	Nearly certain to occur	95%
Absolutely Certain	100% Likelihood	100%

- Describe the input parameter; Annual replacement cost for the microphone
- What is the Most Likely value, M? \$ 1,500,000
- Adjust M if needed.
- What is the chance the actual value could exceed M? Extremely Unlikely
- What is the lowest value, L? \$ 1,500,000
- What is the chance the actual value could be less than L? Extremely Unlikely
- What is the Highest value, H? \$ 6,000,000
- What is the chance the actual value could be higher than H? Very Unlikely

Risk Triangular values	Mean	Low	Most Likely	High
	\$ -	1500000	1500000	6000000



Choose Custom Parameters

First parameter: 5 % Second parameter: %

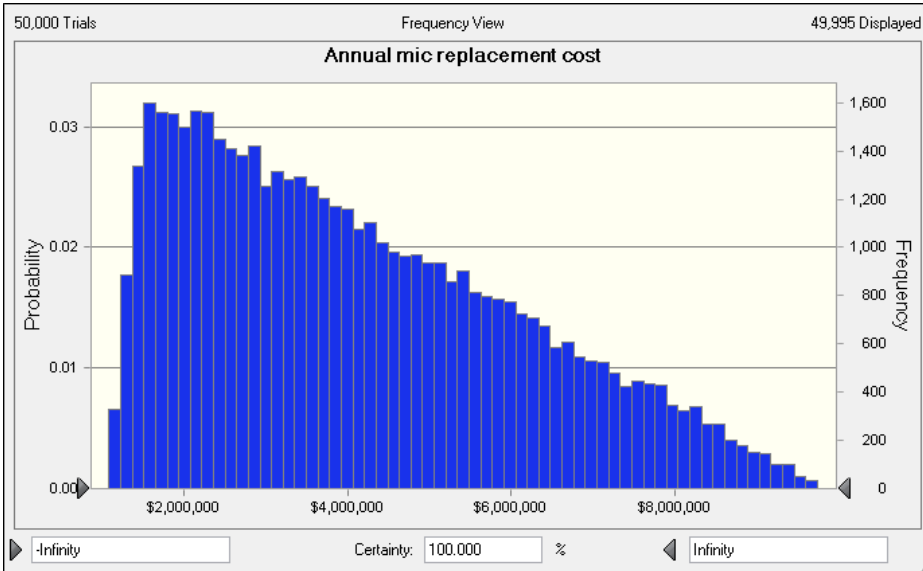
Minimum Likeliest

Third parameter: 80 %

Maximum

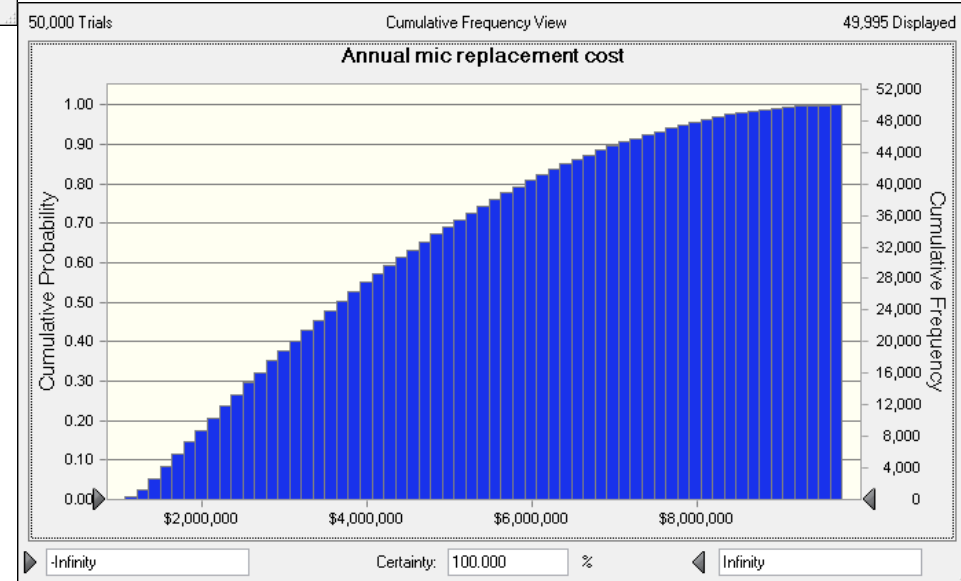
Buttons: OK, Cancel, Help

Assess the new risk



First iteration results

Percentile	Forecast values
0%	\$1,073,811
10%	\$1,721,449
20%	\$2,182,075
30%	\$2,665,935
40%	\$3,194,571
50%	\$3,759,451
60%	\$4,387,761
70%	\$5,126,745
80%	\$5,978,133
90%	\$7,110,390
100%	\$9,781,319



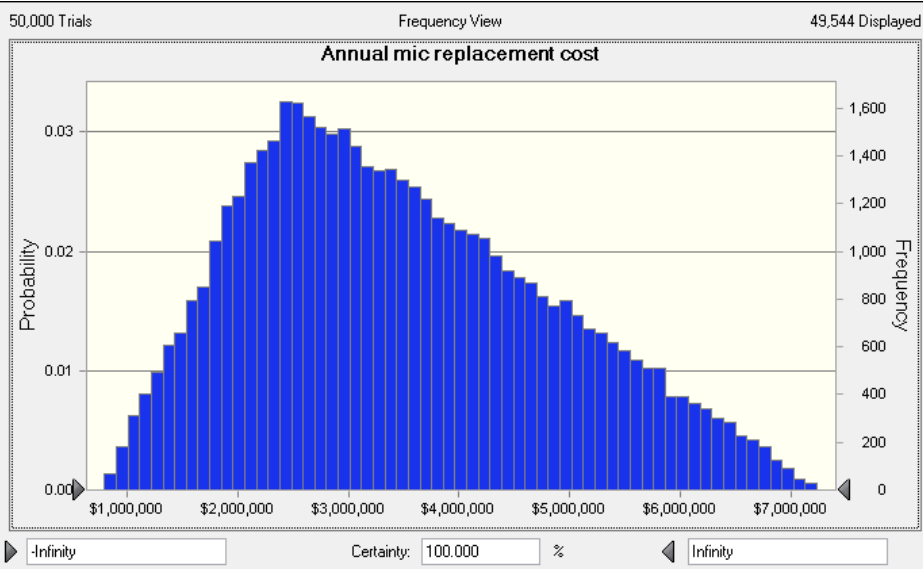
Repeat the process

Descriptor	Description	Probability
Absolutely Impossible	No possibility of occurrence	0%
Extremely Unlikely	Nearly impossible to occur	5%
Very Unlikely	Highly unlikely to occur; not common	20%
Somewhat Unlikely	Indifferent between "Very Unlikely" & "Even chance"	35%
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Somewhat Likely	Indifferent between "Very Likely" & "Even chance"	65%
Very Likely	Highly likely to occur; common occurrence	80%
Extremely Likely	Nearly certain to occur	95%
Absolutely Certain	100% Likelihood	100%

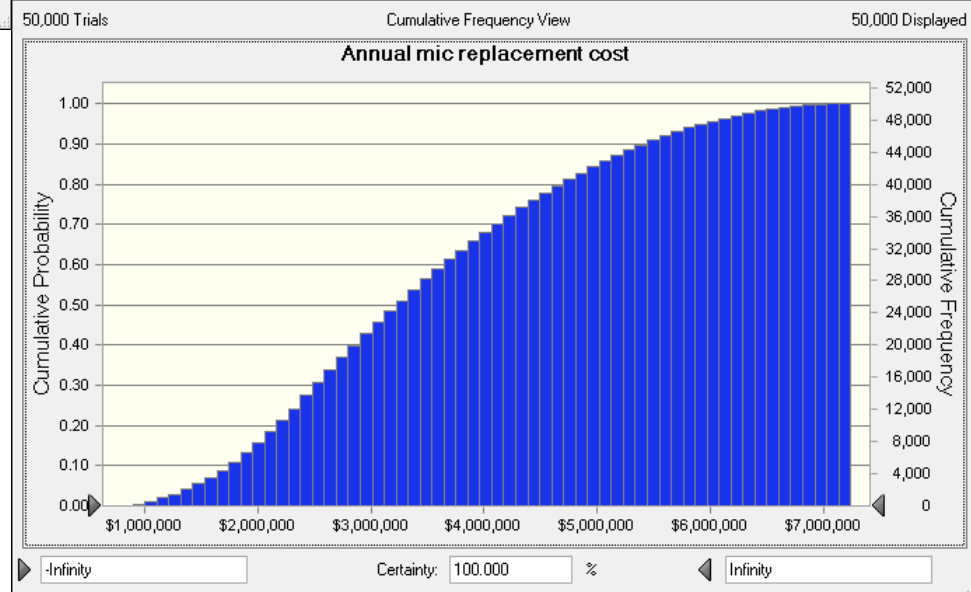
2. Describe the input parameter: Annual replacement cost for the microphone	
3. What is the Most Likely value, M?	\$ 1,500,000
4. <i>Adjust M if needed.</i>	\$ 2,400,000
5. <i>What is the chance the actual value could exceed M?</i>	Even Chance
6. What is the lowest value, L?	\$ 1,500,000
7. What is the chance the actual value could be less than L?	Extremely Unlikely
8. What is the Highest value, H?	\$ 6,000,000
9. What is the chance the actual value could be higher than H?	Extremely Unlikely

Risk Triangular values	Expected Value	Low	Most Likely	High
	\$ 3,288,367	\$ 1,500,000	\$ 2,400,000	\$ 6,000,000

Repeat the process

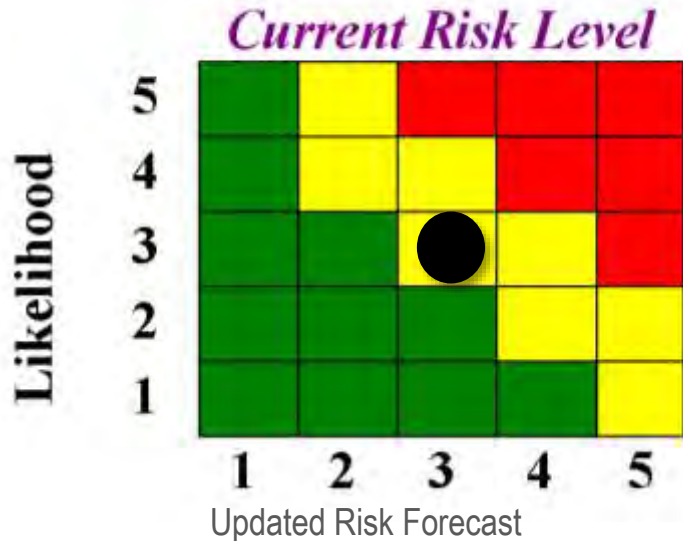


Second iteration results



Percentile	Previous Forecast	New Forecast
0%	\$1,073,811	\$793,060
10%	\$1,721,449	\$1,807,416
20%	\$2,182,075	\$2,227,737
30%	\$2,665,935	\$2,566,498
40%	\$3,194,571	\$2,911,291
50%	\$3,759,451	\$3,284,497
60%	\$4,387,761	\$3,690,500
70%	\$5,126,745	\$4,162,424
80%	\$5,978,133	\$4,720,753
90%	\$7,110,390	\$5,457,797
100%	\$9,781,319	\$7,234,274

Fully Quantified Risk – connecting dots

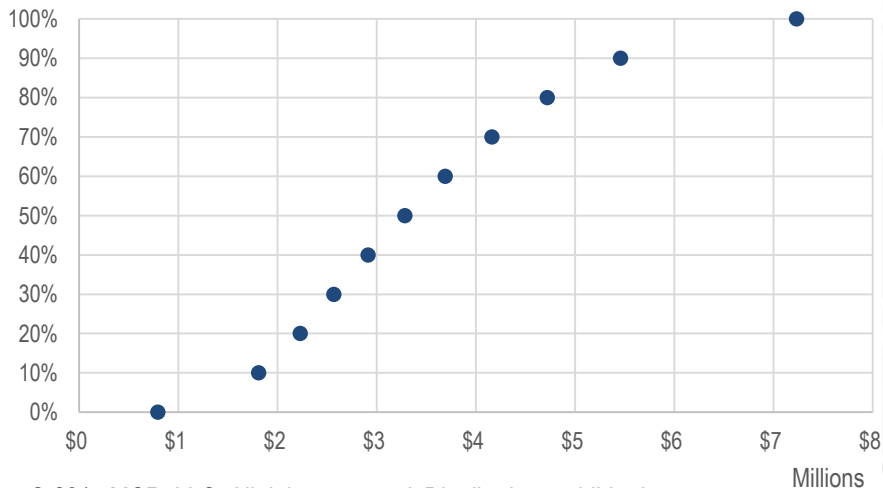


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Likelihood (y)

Consequence (x)

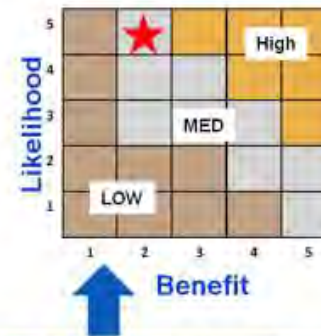
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Future Analysis/Applications

- Should cost analysis with the opportunity matrix

What is the likelihood the Opportunity will happen?		
Level	Planned Approach and Process	
1	Not Likely (30%)	...unproven technology or methods that will have to be developed & are difficult to estimate.
2	Low Likelihood (30%)	...Implementation may not work or may require additional funding along the way.
3	Likely (50%)	...may be some experimentation involved to
4	Highly Likely (70%)	...Implementation risk, but there are alternate ways to achieve the opportunity.
5	Near Certainty (90%)	Steps are well known, common methods and/or technologies are used.



Level	Technical	Schedule	Cost
1	Minimal benefit to technical performance	Minimum impact to program schedule	Minimal or no impact
2	Minor increase in technical performance and/or supportability	No impact to critical path, potential non-critical path improvement of <3 month.	<0.1%
3	Moderate increase in technical performance and/or supportability	Potential non-critical path schedule of 3-6 months, potential critical path improvement of <1 month.	<0.5%
4	Major increase in technical performance and/or supportability	Potential non-critical path schedule of <6 months, potential critical path improvement of <1 month.	<1.0%
5	Exceptional increase in technical performance and/or supportability that exceeds key technical or supportability thresholds	Potential schedule improvement of >1 month on critical path	>1.0%

Definitions derived from NAVAIRINST 5000.21B

- Correlation studies between risks and opportunities
- Determining appropriate incentive fees