NORTH AMERICAN SOCIETY FOR TRENCHLESS TECHNOLOGY

IT'S NOT JUST A LINE ON A PIECE OF PAPER

or

Risk Based Engineering for Trenchless Projects

DENNIS J DOHERTY, PE, F.ASCE

NASTT's 2018 No-Dig Show

What is Risk?

Wikipedia defines **risk management** as:

"the identification, assessment, and prioritization... application of resources to minimize, monitor, and control the probability and/or impact of unfortunate events..."

What is Risk Management?

"The strategies to manage risk include transferring the risk to another party, avoiding the risk, reducing the negative effect of the risk, and accepting some or all of the consequences of a particular risk."

Paper ID # WM-T2-04

Risk Analysis and Management Process

- What are the risks?
- What is the probability of losses from them?
- How much are the losses likely to cost?
- What might the losses be if the worst happens?
- What are the alternatives?
- How can the losses be reduced or eliminated?
- Will the alternative produce other risk?

Independent Review

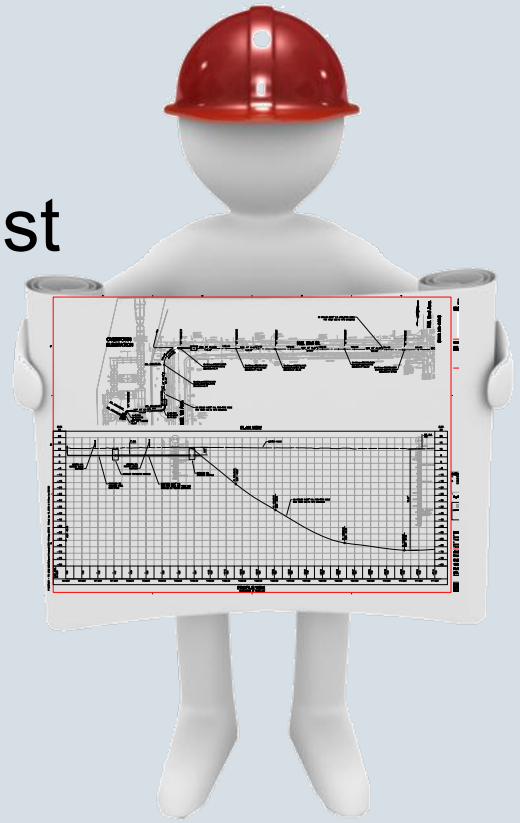
- PEER Review
- Value Engineering
- Constructability Review
- Contractor or Engineers with Expertise in Method Proposed
- Brain storming

Five Basic Responses

- **Accept-** There is nothing that can be done to mitigate the risk. You have to accept it or hope it does not occur.
- **Avoid-** The project plan can be modified so as to avoid the situation that creates the risk
- **Contingency planning-** If the risk occurs, what will you do?
- **Mitigate**-What will you do to minimize the impact should the risk event occur?
- **Transfer-** Pass the impact should the risk event occur

Why Risk Based Engineering for Trenchless Projects is Important

- Identify Project Needs, Requirements and Potential Cost
  - Identify requirements
  - Identify potential problems
  - Identify mitigation methods
  - Identify potential cost
- Control Project Cost



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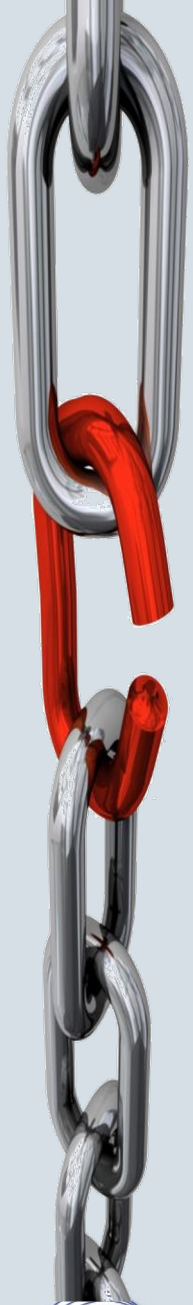
Risk Assessment

- Risk Events may Translate to Financial Losses or Gains
- Types of Risk:
  - Change Creep
  - Scope Creep
  - Money Limitation
  - Changed Ground Conditions
  - Resource Queuing
  - Proper tooling
  - Third party property
  - Access to work zones
  - property rights
  - Scheduling

Risk Assessment and Cost

- Types of Consequences
  - Additional cost for change order
  - Not all systems delivered at desired quality
  - Additional cost to fix problems
  - Additional cost required to replace Subs
  - Delays in project schedule (deliverable milestone)
  - Additional cost for higher labor cost
  - Retraining of students at additional cost
  - Delay in project schedule due to poor QA/QC procedures.



Risk Evaluation

- **Low Risk:** Risk score below 19 = monitor risk
- **Medium Risk:** Risk score between 20 and 34, consider risk mitigation plan
- **High Risk:** Risk score between 35 to 63 – change design or conduct additional investigations to design mitigation.

Risk Modifiers

Increasing risk

- Undefined scope
- Limited budget
- Micro-managing
- Limited resources
- Execution of contract and integration of software/hardware against recommendations of equipment manufacturers suppliers

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Risk Modifiers

Decreasing risk

- Well defined scope
- Good understanding of geological conditions
- Good understanding of various trenchless methods
- Communications
- Early procurement of long lead items
- Scheduling of resources ahead of time
- Well defined procedures

Risk Management Techniques

- identify, characterize, and assess threats
- identify the probability of risk event occurring
- assess the vulnerability of critical assets to specific threats
- determine the risk (i.e. the expected consequences of specific types of attacks on specific assets)
- identify ways to reduce those risks
- prioritize risk reduction measures based on a strategy

http://en.wikipedia.org/wiki/Risk_management

Risk Register

- Identify Risk.
- Identify impact of Risk
- Identify probability
- Identify risk score
- Identify cost or schedule impacts
- Identify solution

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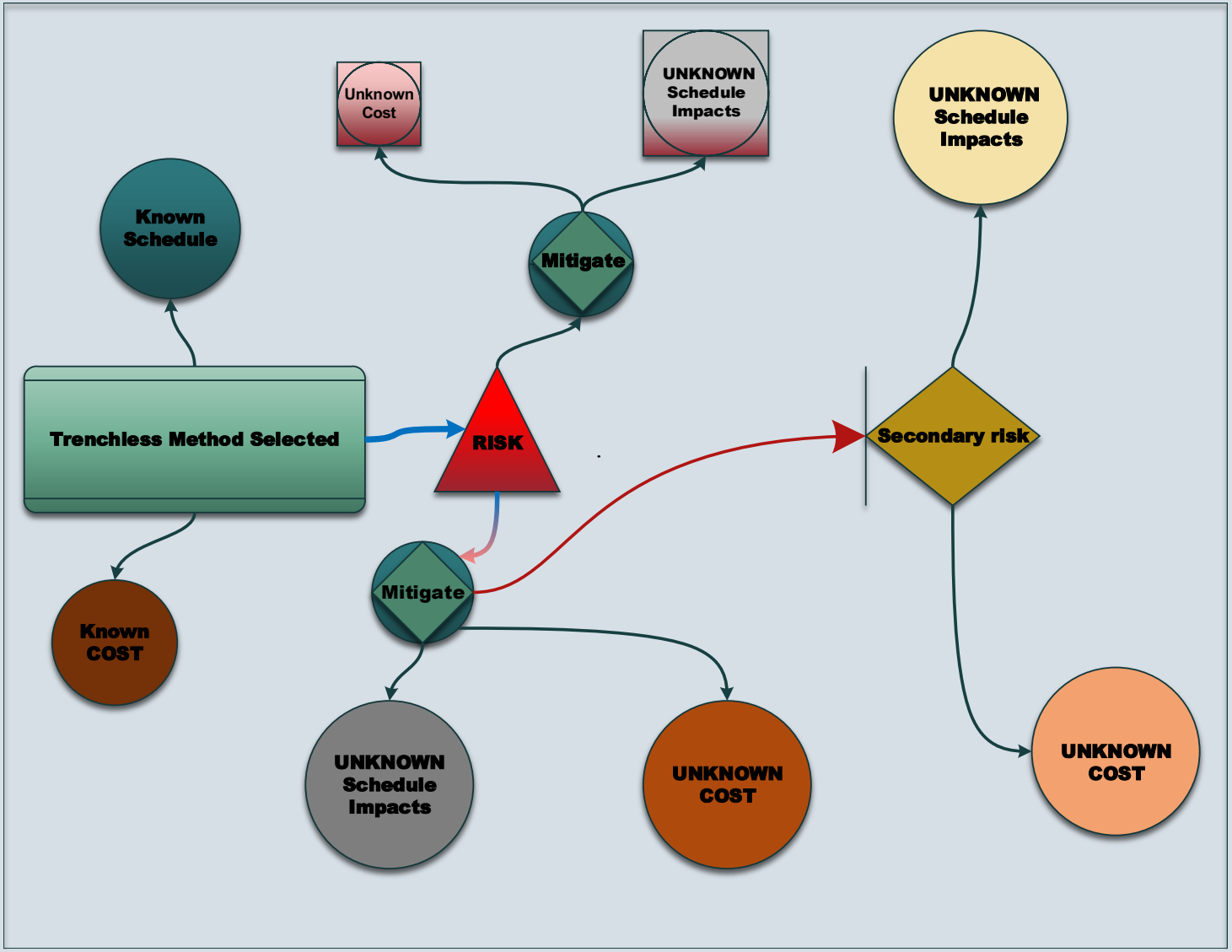
Risk Assessment

Risk Identification					Qualitative Analysis				
					Probability		Impact		Risk Qualitative Rating
Risk ID	Date Identified	Identified by	Risk Occurrence Phase	Risk Description	Description	Rating	Description	Rating	
18	2-Apr-17	DJD	Design & Construction	Relocation of one or both of telecom on west side requires at least partial relocation	Will happen	9	Moderate effect	5	45
19	2-Apr-17	DJD	Design & Construction	Relocation of electric duct bank, others east side	Will probably happen	7	Moderate effect	5	35
20	2-Apr-17	DJD	Design & Construction	Limited pipe assembly areas for HDD (HDPE near cinemas)	Unlikely to happen	3	Significant effect	7	21
21	2-Apr-17	DJD	Design & Construction	Limited pipe assembly areas for Direct Pipe	Unlikely to happen	3	Significant effect	7	21
22	2-Apr-17	DJD	Design & Construction	Work space constraints for HDD operations (Midi Rig)	Could happen	5	Moderate effect	5	25
23	2-Apr-17	DJD	Design & Construction	Work space constraints for Direct Pipe operations	Could happen	5	Moderate effect	5	25
24	2-Apr-17	DJD	Design & Construction	Work space constraints for Microtunnel operations	Could happen	5	Moderate effect	5	25
25	2-Apr-17	DJD	Facility Planning & Design	Cable pull issues due to geometry	Could happen	5	Severe Effect	9	45
26	2-Apr-17	DJD	Facility Planning & Design	Thermal issues due to geology	Could happen	5	Severe Effect	9	45

Risk Cost

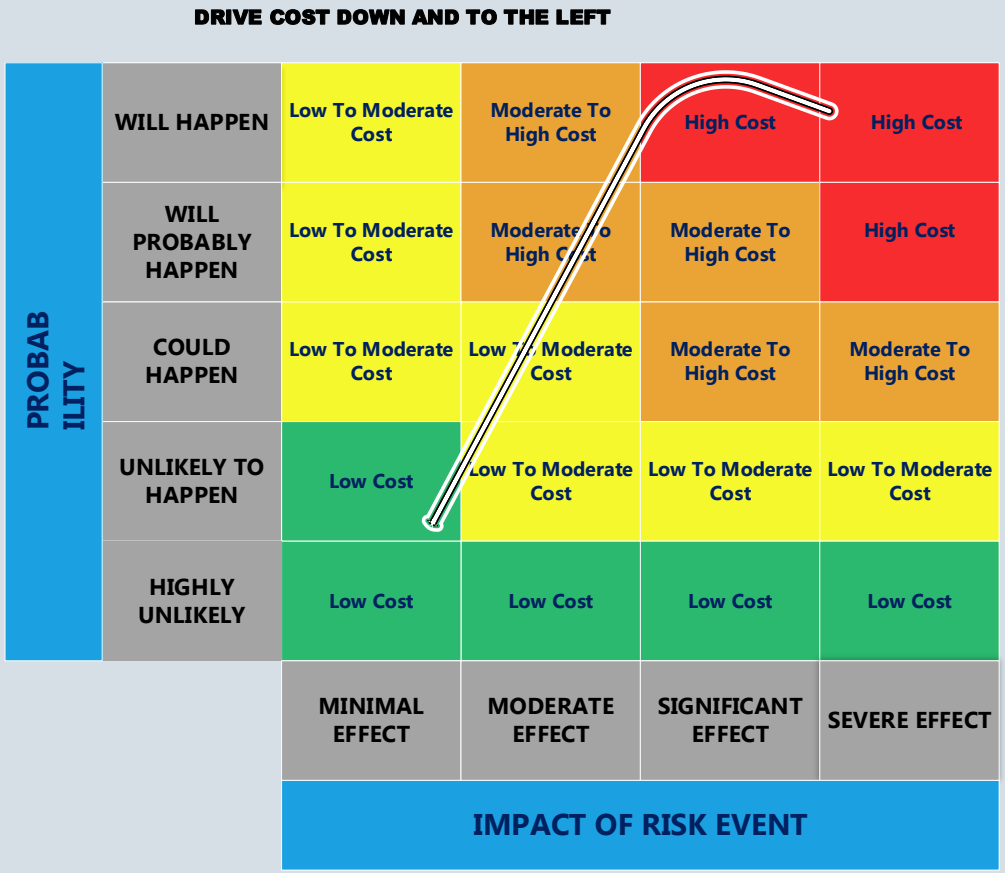
Risk Description	Risk Analysis – Quantitative Analysis							
	Risk Probability (%)	Potential Schedule Impact (Weeks)	Type of Schedule Impact	Impacts Milestone?	Potential Cost Impact (K$)	Cost Estimate Class	Expected Risk Exposure	
							(Weeks)	(K$)
Relocation of one or both of telecom on west side requires at least partial relocation	90%	52	Unknown	Yes	15	Rough Order of Magnitude	47	14
Relocation of electric duct bank, others east side	70%	36	Critical Path	Yes	10	Rough Order of Magnitude	25	7
Limited pipe assembly areas for HDD (HDPE near cinemas)	30%	26	Critical Path	Yes	100	Rough Order of Magnitude	8	30
Limited pipe assembly areas for Direct Pipe	30%	4	Critical Path	Yes	25	Rough Order of Magnitude	1	8
Work space constraints for HDD operations (Midi Rig)	50%	16	Critical Path	Yes	25	Rough Order of Magnitude	8	13
Work space constraints for Direct Pipe operations	50%	16	Critical Path	Yes	25	Rough Order of Magnitude	8	13
Work space constraints for Microtunnel operations	50%	16	Critical Path	Yes	25	Rough Order of Magnitude	8	13
Cable pull issues due to geometry	50%	26	Critical Path	Yes	25	Rough Order of Magnitude	13	13
Thermal issues due to geology	50%	52	Critical Path	Yes	125	Rough Order of Magnitude	26	63

Unknown cost of Risk



Engineering & Risk

Drive cost of risk down



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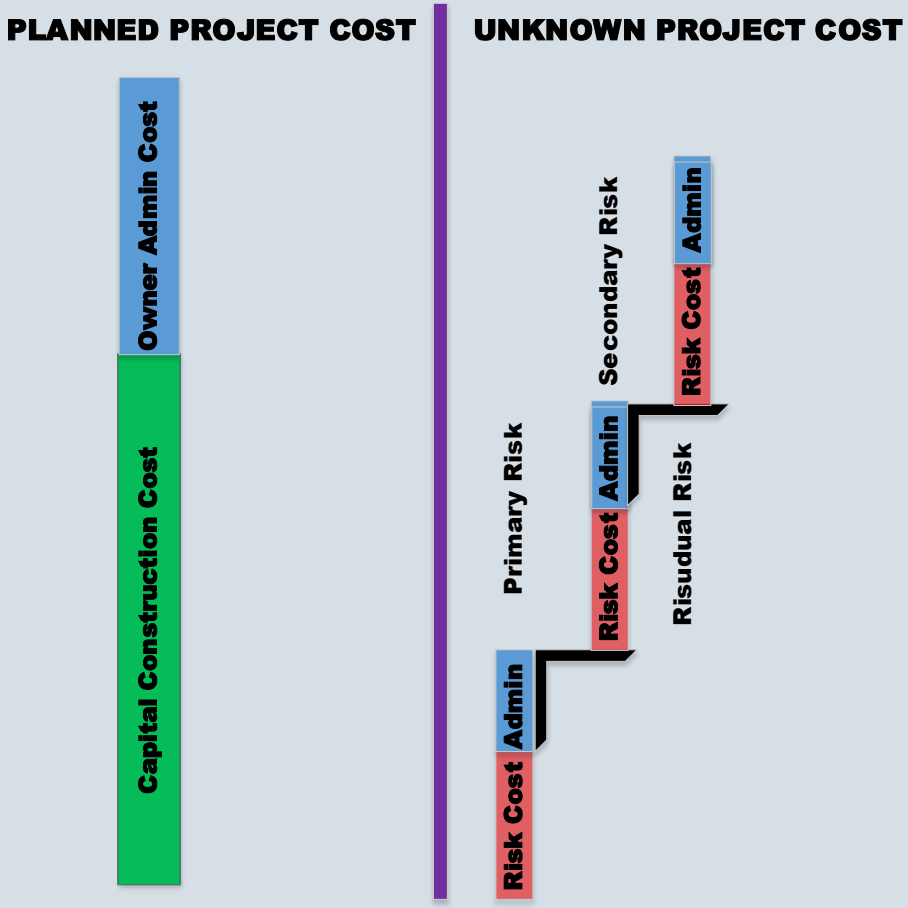
Adding up the Cost of Risk



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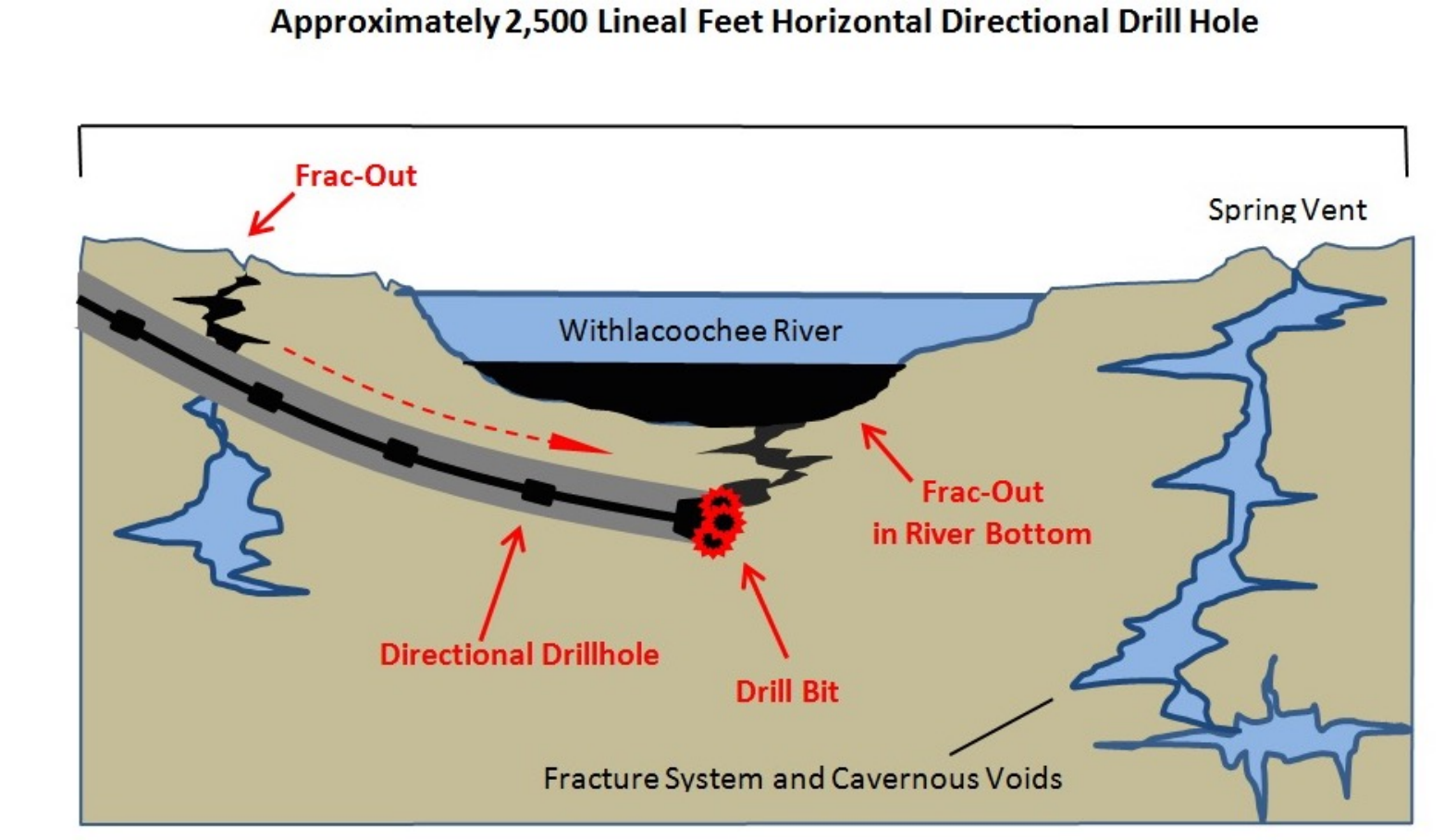
Example


Approximately 2,500 Lineal Feet Horizontal Directional Drill Hole
Frac-Out
Spring Vent
Withlacoochee River
Frac-Out
in River Bottom
Directional Drillhole
Drill Bit
Fracture System and Cavernous Voids

Quantitative Risk Analysis - Results

- Top Risks
  - Inadvertent Returns- Shallow drill or bad geology can increase risk of inadvertent returns. Unanticipated change due to mud on surface at unplanned location resulting in additional cost for change order to clean mud [Time/Cost Probability= 50%; Time Impact = 1 week; Cost Impact= $200,000; Time EV = 0; Cost EV=$100,000]
  - Mitigation – Increase depth of alignment. Shift in Probability to 20%, decrease in risk cost $40,000
  - Risk mitigation relatively low cost at additional $20,000

Q&A

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