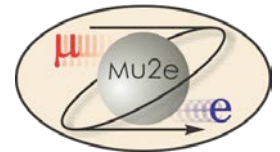




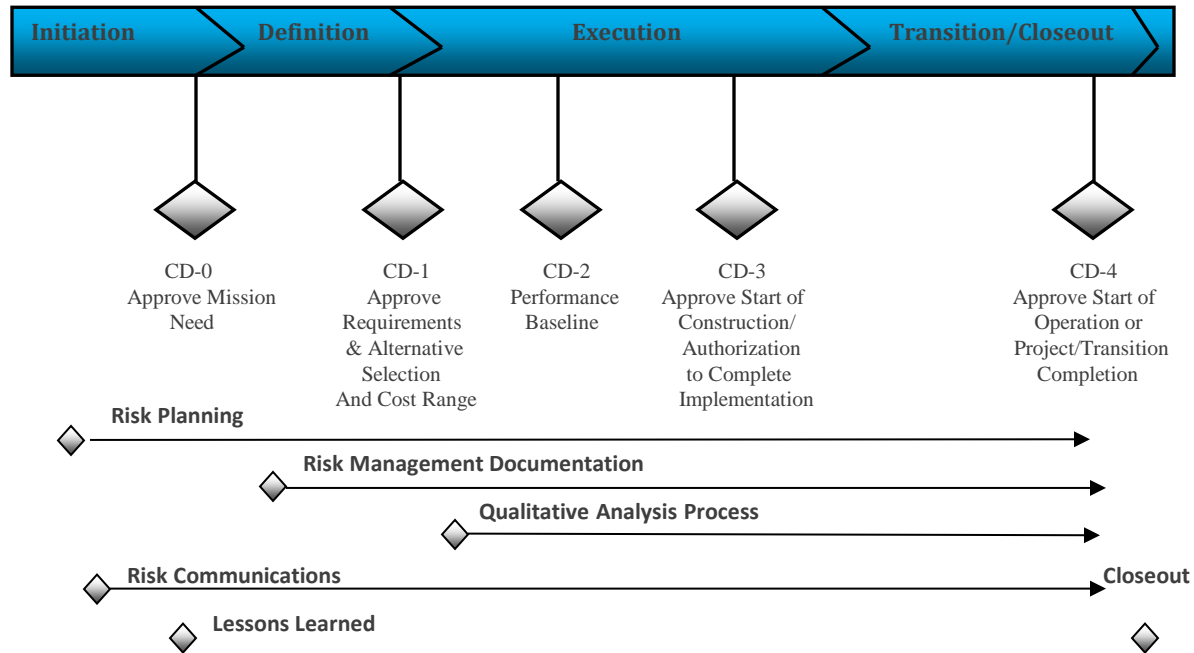
U.S. DEPARTMENT OF
ENERGY Office of
Science

Mu2e Risk Management

Mike Dinnon
Risk Manager
7/8/2014



RISK MANAGEMENT DURING CD PHASES



Critical Decision Phases with continuous and iterative risk management.

Definition of Risk

Situations that have potential to cause an unwanted or undesired change in schedule, cost, scope, ES&H or technical success are described as risks. A risk is explained as a definable event with a probability of occurrence and a consequence or impact to the Project if it occurs. The event can have a positive (opportunity) or negative (threat) effect on the Project.

$$\text{Risk Severity} = \text{Probability} \times \text{Impact}$$

Outline

- Introduction
- Definition of Risk
- Key Elements of Risk Management
 1. Risk Planning
 2. Risk Identification
 3. Qualitative Risk Analysis
 4. Quantitative Risk Analysis
 5. Risk Mitigation Strategies
 6. Risk Monitoring
- Future Process
- Summary

KEY ELEMENTS OF RISK MANAGEMENT

1. Risk Planning
2. Risk Identification
3. Qualitative Risk Analysis
4. Quantitative Risk Analysis
5. Risk Handling and Mitigation Strategies
6. Risk Monitoring

Risk Planning

- Sets the process and standards to which the Project manages and documents risk
 - Create Risk Management Plan
 - Set up risk identification process
 - Identify key team members
 - Establish Risk Management Board (RMB) = Technical Board
 - Training on the risk process

Risk Identification

- Risk items are identified by team members and documented.
- Clearly states the risk event and impact to the Project.
- Interdependencies within the Project are noted
- Compilation is assembled and reviewed at the Subproject level then submitted to the Project Office.
- Risks are then combined and the Project decides on those risks to be included in the Project risk register.
- Currently Mu2e risk register contains 48 entries
 - 12 opportunities 36 Threats
 - \$5.1M Exposure At 90% Confidence

Qualitative Analysis

Risk scoring has two dimensions:

- impact and probability.
- Impact is the potential impact of a risk
- The highest impact score gives the impact score of the risk item.

Table 1: Impact Assessment Matrix. Impacts range from *Very Low* to *Very High*.

Impact Risk	Very Low	Low	Moderate	High	Very High
Cost	< \$50K	\$50K - \$100K	\$100K - \$250K	\$250K - \$500K	> \$500K
ES&H	Negligible	Minimal	Concern	Significant risk	High risk
Schedule	Delays Level 3 milestone or Project critical path by < 1 month	Delays Level 3 milestone or Project critical path by 1 - 3 months	Delays Level 3 milestone or Project critical path by 3 - 6 months	Delays level 3 milestone or Project critical path by 6 - 9 months	Delays Level 3 milestone or Project critical path by > 9 months
Technical	Negligible	Negligible, if any, degradation.	Significant technical degradation.	Technical performance effectively useless for attaining physics objectives.	Technical performance useless for attaining physics objectives.

Qualitative Analysis

Risk scoring has two dimensions:

- impact and probability.
- Impact is the potential impact of a risk
- The highest impact score gives the impact score of the risk item.
- The probability score assigns a ranking, using the parameters in Table 2, gauged on how likely the event is to occur.
- The risk owner makes the first scoring determination which is then evaluated by the RMB and Project Manager.

Qualitative Analysis

- An overall risk score is given to each risk item by a composite of the impact and probability score.

Table 2: Risk Classification Matrix

Probability	Impact				
	Very Low	Low	Moderate	High	Very High
Very High (> 90%)	Low	Moderate	High	High	High
High (75% – 90%)	Low	Moderate	Moderate	High	High
Moderate (25% - 75%)	Low	Low	Moderate	High	High
Low (10% - 25%)	Low	Low	Moderate	Moderate	High
Very Low (< 10%)	Low	Low	Low	Low	Moderate

Qualitative Analysis

Table 1: Impact Assessment Matrix. Impacts range from *Very Low* to *Very High*.

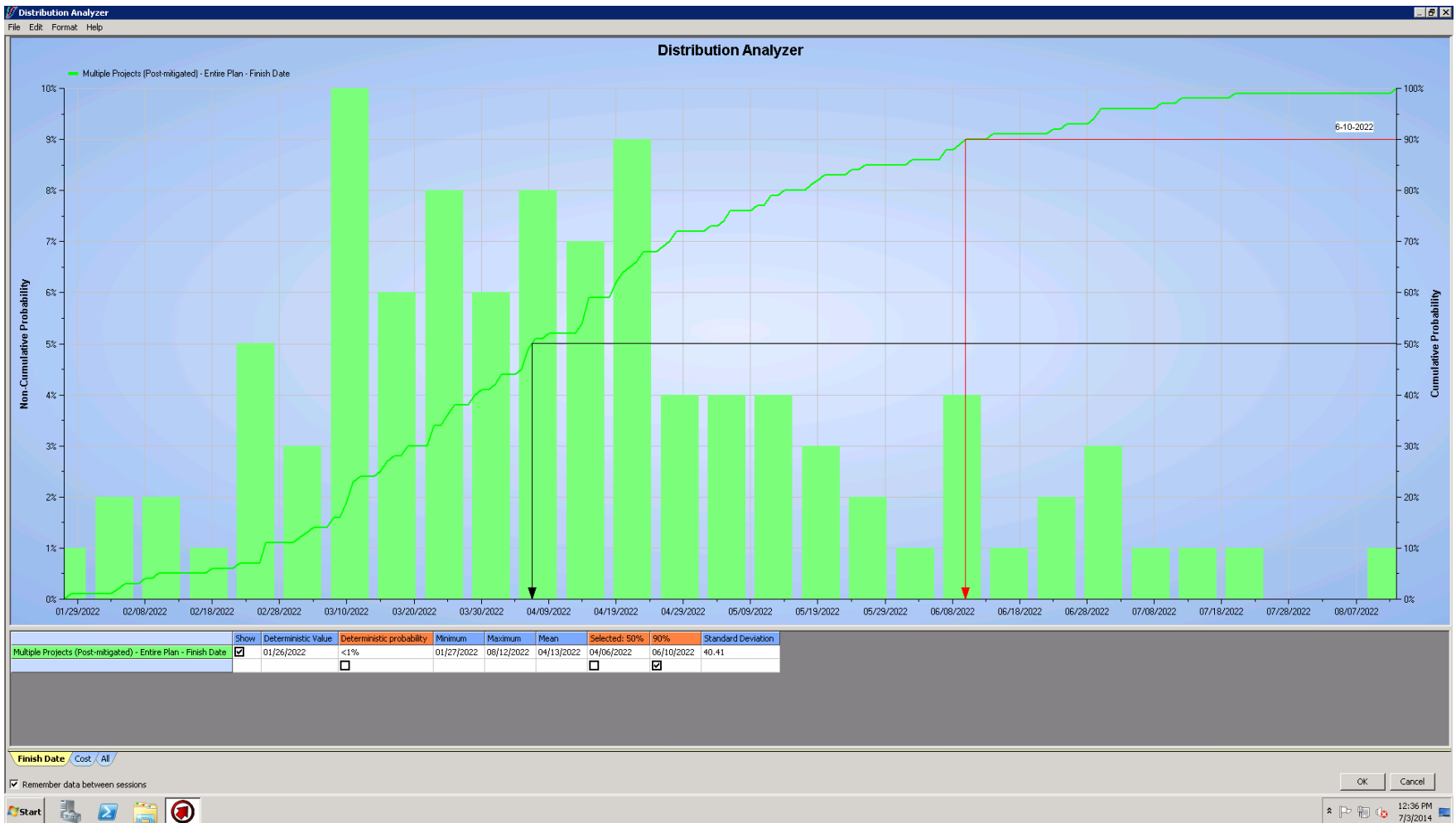
Impact Risk	Very Low	Low	Moderate	High	Very High
Cost	< \$50K	\$50K - \$100K	\$100K - \$250K	\$250K - \$500K	> \$500K
ES&H	Negligible	Minimal	Concern	Significant risk	High risk
Schedule	Delays Level 3 milestone or Project critical path by < 1 month	Delays Level 3 milestone or Project critical path by 1 - 3 months	Delays Level 3 milestone or Project critical path by 3 - 6 months	Delays level 3 milestone or Project critical path by 6 - 9 months	Delays Level 3 milestone or Project critical path by > 9 months
Technical	Negligible	Negligible, if any, degradation.	Significant technical degradation.	Technical performance effectively useless for attaining physics objectives.	Technical performance useless for attaining physics objectives.

Quantitative Analysis

Schedule Risk

- Analyzed all schedule risks individually as to see the effect on cost of the maximum amount of delay (risk register then adjusted)
- Modeled only schedule risks against the plan and ran a MC
- Modeled ALL risks against the plan and ran a MC
- Result shows that we fall under the Project milestone of 12-5-2022 with an analysis showing 90% confidence in 6-10-2022

Quantitative Analysis

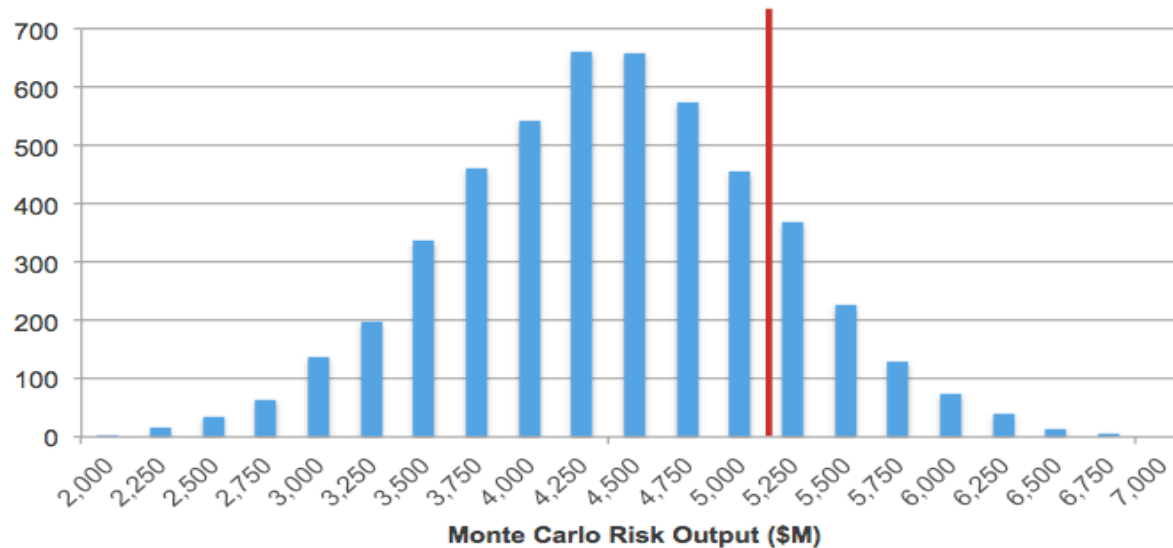


MC on Finish date shows 6-10-2022 date

Quantitative Analysis

Risk Analysis

Monte Carlo performed on Risk Register to determine cost at 90% C.L.



Mean	\$4.3M
σ	\$0.78M
90% C.L.	\$5.1M

L2	90% C.L. Risk
Project Management	\$1208
Accelerator	\$982
Conventional Construction	(\$510)
Solenoids	\$1196
Muon Beamline	\$499
Tracker	\$651
Calorimeter	\$523
Cosmic Ray Veto	\$323
DAQ	\$273
Total	\$5145

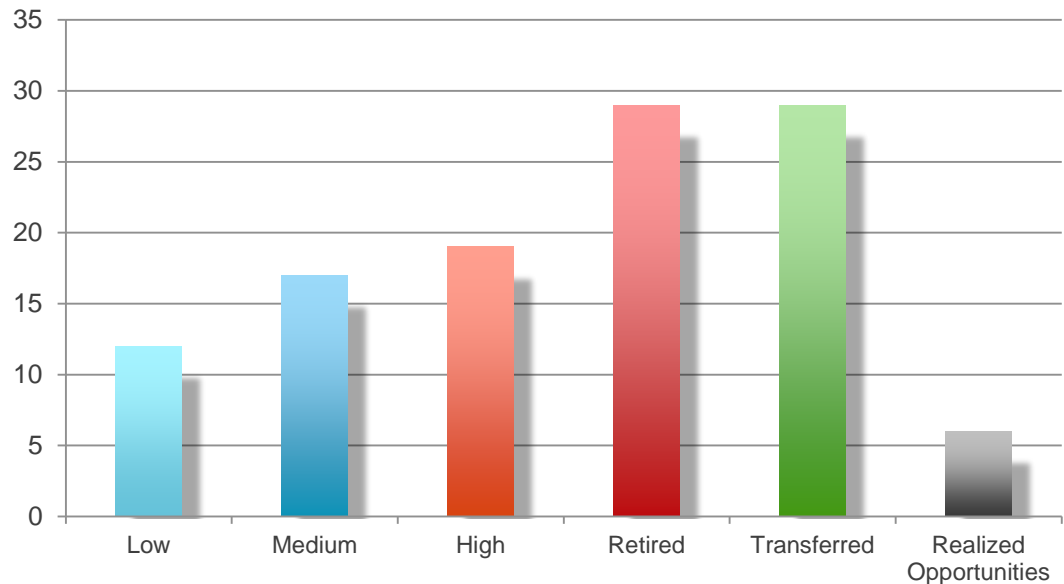
CD-2 Register

Since CD-1

- 29 Risks retired
- 6 opportunities realized at a savings of \$1.7M
- >\$6M spent to mitigate risks
- Loaded into PRA for analysis

Current

- 48 Entries
- Register - \$5.1M



Handling and Mitigations

- Mitigation plans are developed by the risk owner and implemented into the project plan
- They are reviewed by the Project Manager and L2 manager for effectiveness
- Mitigation plans have a direct impact on the post mitigated risk
 - Reduction of probability and/or impacts to threat events
 - Increase of probability and/or impacts to opportunity events

Risk Monitoring

- The risk owner has a significant role in risk monitoring.
- The risk owner will update information on the risk item's form promptly following recognition. The risk form revision is submitted to the Risk Manager who assigns the change for review at the next RMB/TB meeting. Upon approval of the change, the Risk Manager will update the Risk Register accordingly.
- After CD-2, the Risk Manager will prepare a monthly report that identifies any and all changes to the Risk Register in the previous month.

Future Process

- Continue to iterate on current risk events and track
- Provide risk reports to the project
- Further develop the MC analysis parameters
- Map a risk spend down plan against the funding profile
- Identify new risks as they appear

Summary

- Mu2e has a solid foundation of risk entries that all members have agreed on.
- A Risk Management Plan has been developed by the project.
- Mu2e feels that the Project's Risk Program is acceptable and ready for a CD-2 approval.
- Iterative process will continue throughout the life cycle of the Project.

Thank You

Backup slides

