



# Psychological Barriers to Recognizing Risk

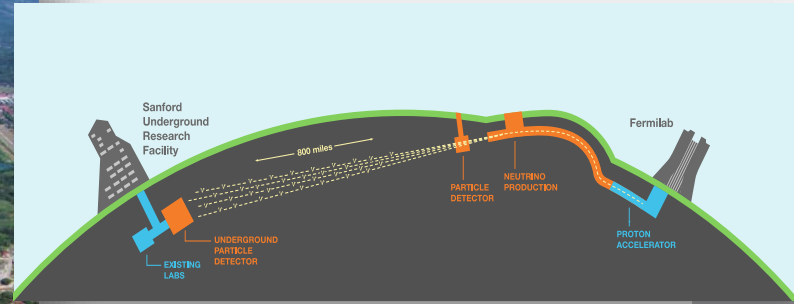
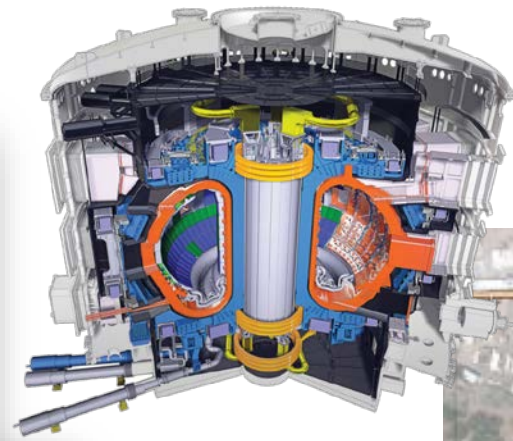
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# Introduction





# Learning Objectives

- Choose appropriate levels of risk management
- Describe biases that can impact risk assessments
- Apply results of risk analysis appropriately



# Risk Management Process

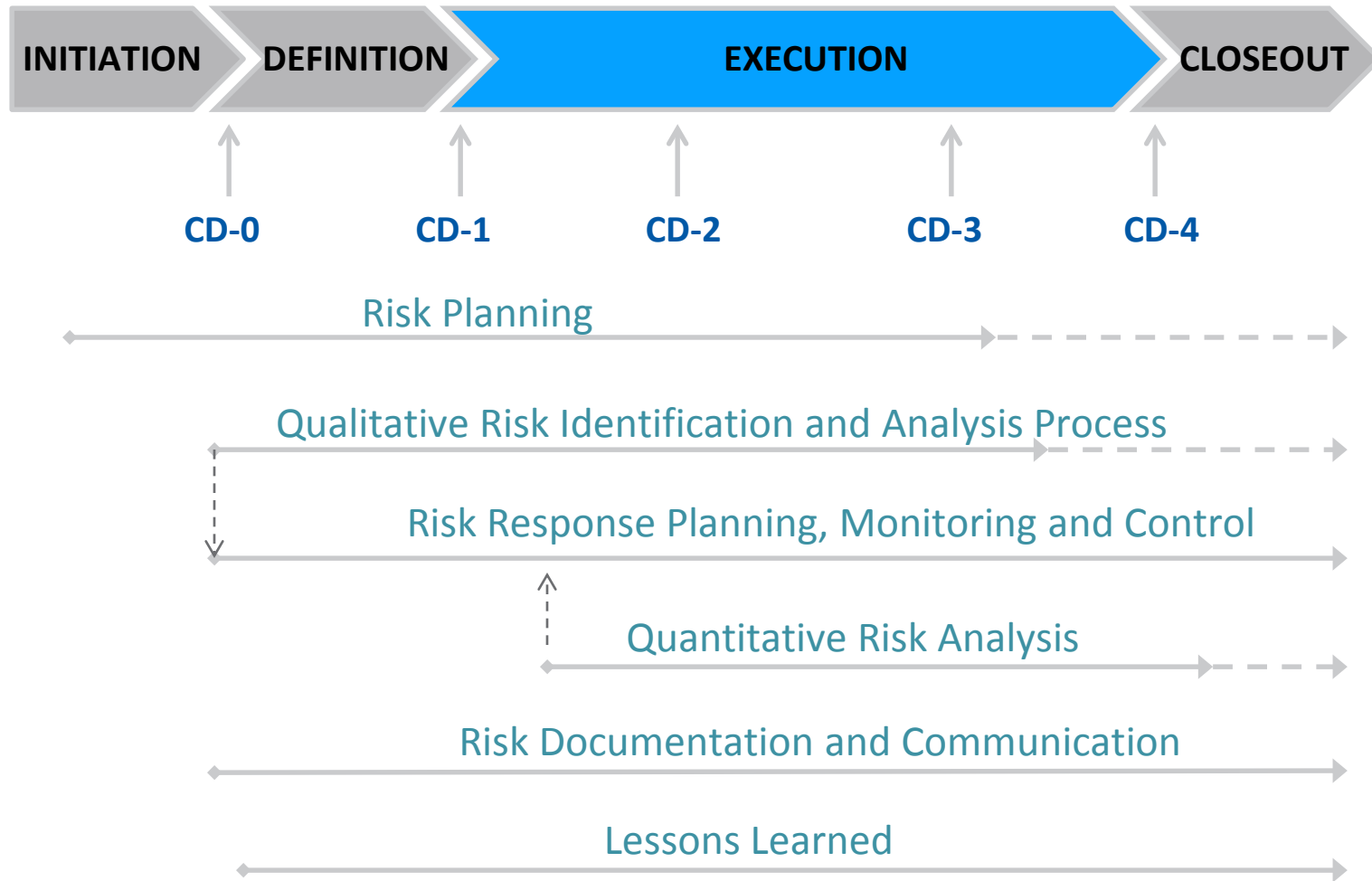
## In a Nutshell

- Formal and structured process
- Anticipate and plan for potential problems and opportunities
- Better understand and control project outcomes

***Risk*** is an uncertain event that, if it occurs, has a negative effect on a project objective

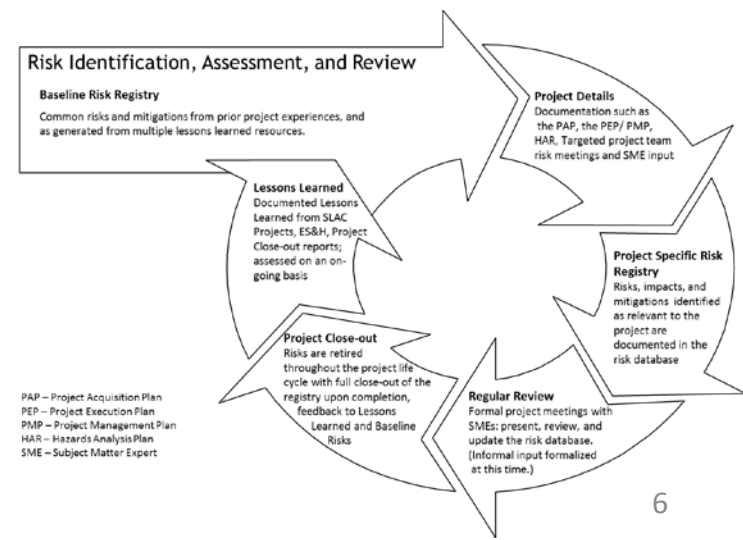
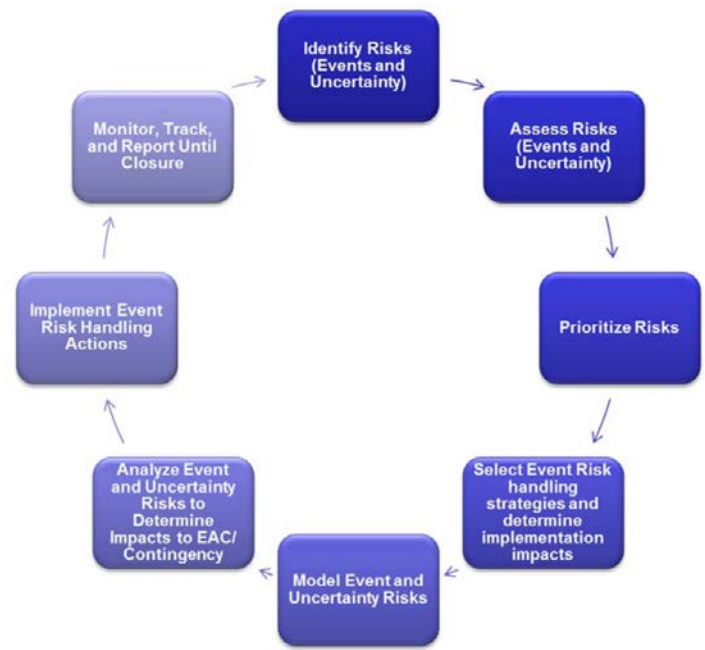
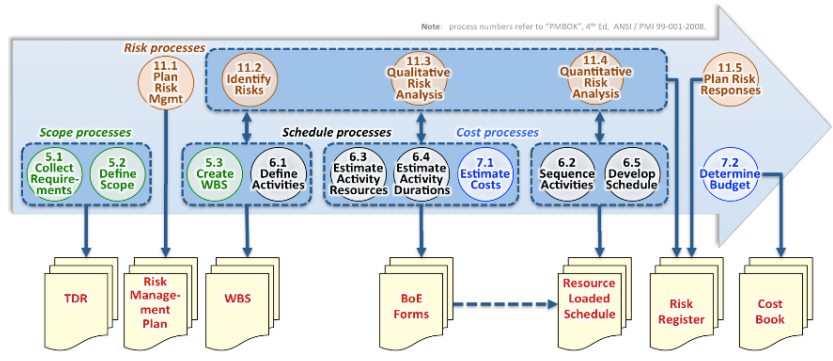


# DOE Risk Management Process





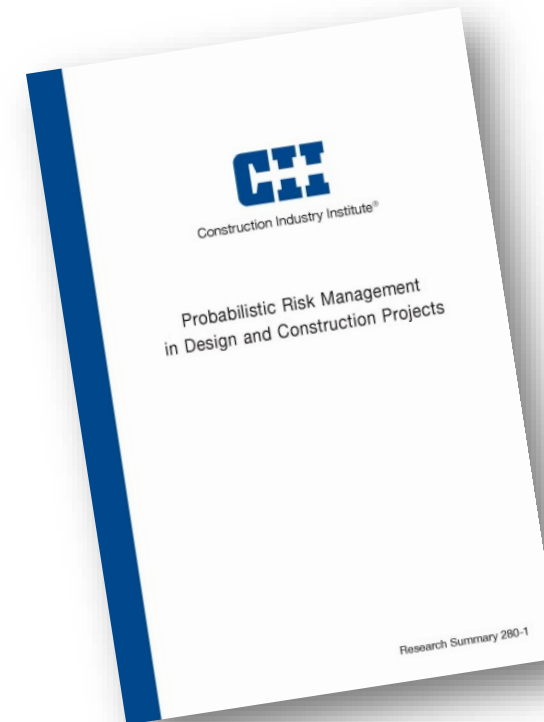
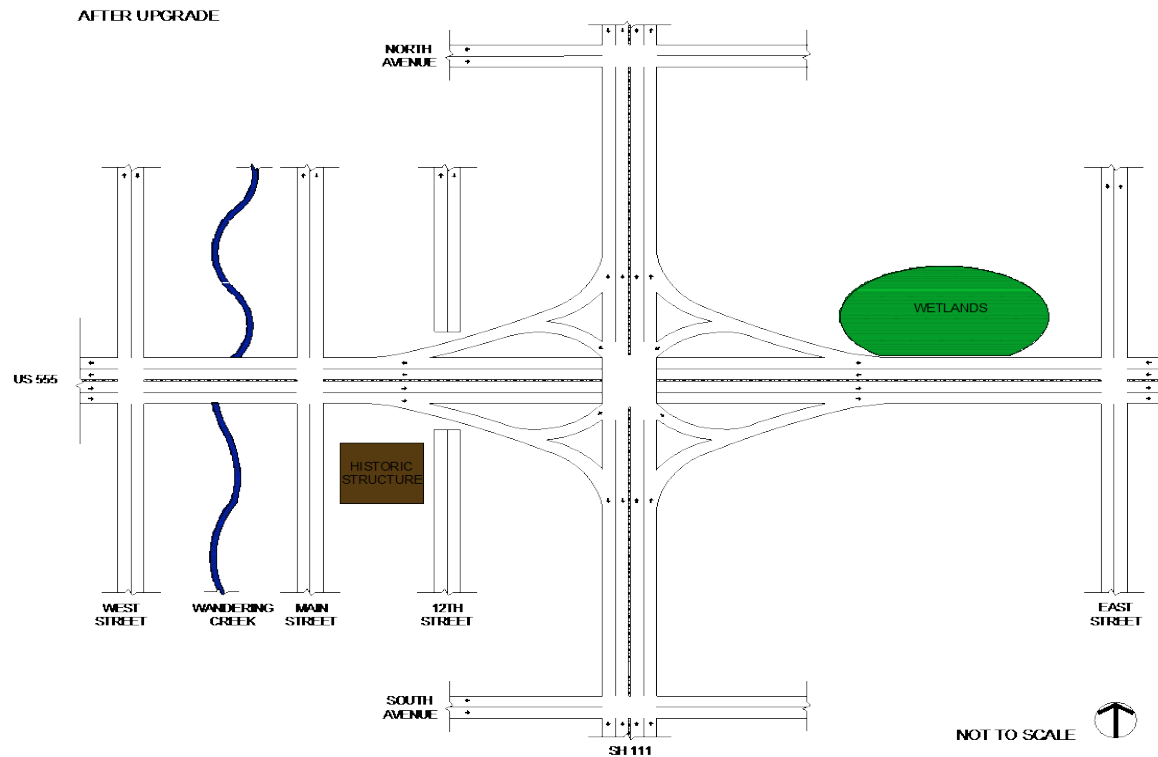
# DOE Risk Management Process Examples





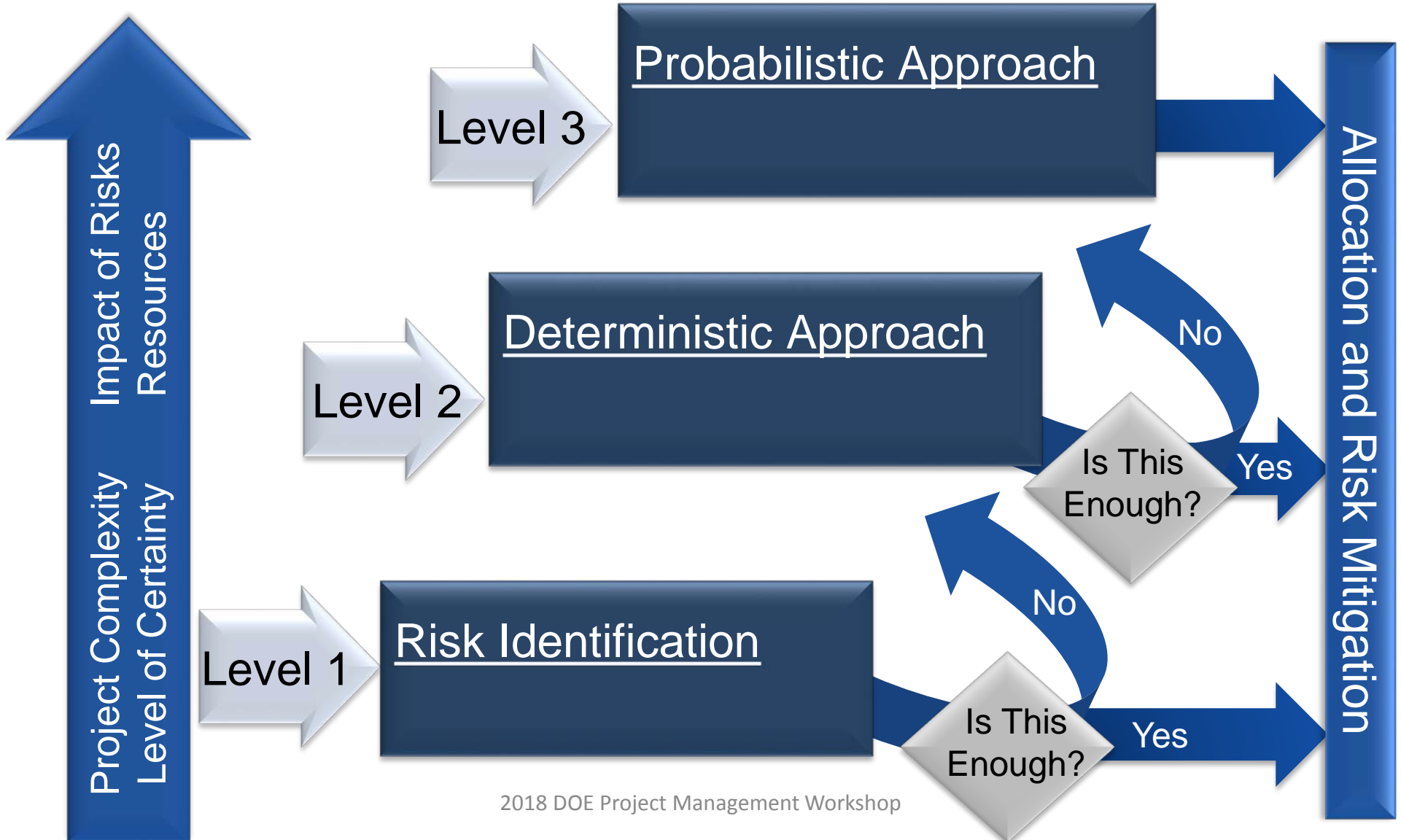
# Appropriate Levels of Risk Management

## Probabilistic Risk Management in Design and Construction Projects Construction Industry Institute (RT 280)





# Appropriate Levels of Risk Management







# Appropriate Levels of Risk Management

LEVEL 1 - RISK IDENTIFICATION											
Item	Status	Date Identified	Brief Risk Description	Detailed Risk Description	CII Project Phases	Category of Impact					
Manual	Drop Down	(M)	<b>LEVEL 2 - DETERMINISTIC</b>								
1	Active	0									
2	Active	0	Item #	Brief Risk Description	Category of Impact	Pre-Mitigated Risk Ranking					
						Most Likely Impact	Most Likely Probability	Risk Mean Value (Dollars)	Overall Risk Ranking		
3	Active	0	<b>LEVEL 3 - PROBABILISTIC</b>								
4	Active	0	Item #	Brief Risk Description	Category of Impact	Cost (Dollars)			Schedule (Days)		
						Best Case	Most Likely	Worst Case	Best Case	Most Likely	Worst Case
5	Active	0	<b>RISK MANAGEMENT</b>								
1	Historic		Item #	Brief Risk Description	Response Action/Strategy	Deterministic: Post-Mitigated Risk Ranking					
						Most Likely Impact	Most Likely Probability	Risk Mean Value + Cost of Mitigation	Overall Risk Ranking		
2	Change in an		Qualitative Value	Qualitative Value	Auto	Auto	Drop Down	Drop Down	Drop Down	Auto	Auto
3	Replace Wandering		1	Change in pavement section and/or type	Mitigate	Low	Low	\$90,000	Low	Low	Low
4	Additional m		3	Replace culvert over Wandering Creek	Transfer	Very Low	Low	\$0	Low	Low	Low
5	Delay in request for proposal		4	Additional wetland mitigation	Mitigate	Low	Very Low	\$22,500	Low	Low	Low
5	Delay in request for proposal		5	Delay in request for proposal	Accept	Medium	Low	\$328,500	Med	Med	Med



# Appropriate Levels of Risk Management



# Appropriate Levels of Risk Management



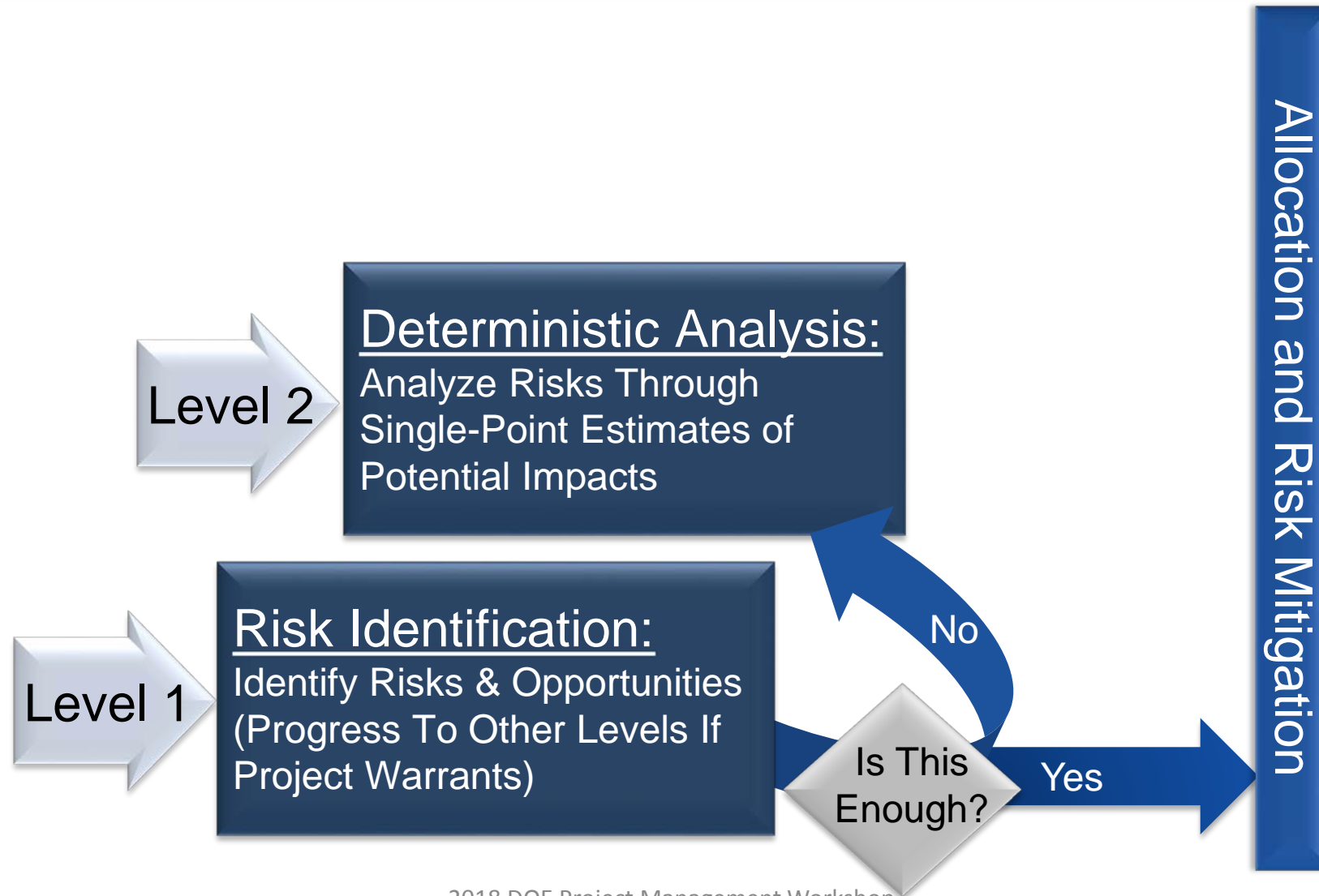


# Appropriate Levels of Risk Management

LEVEL 1 - RISK IDENTIFICATION						
Item	Status	Date Identified	Brief Risk Description	Detailed Risk Description	CII Project Phases	Category of Impact
<i>Manual</i>	<i>Drop Down</i>	<i>Manual (MM/DD/YY)</i>	<i>Manual</i>	<i>Manual</i>	<i>Drop Down</i>	<i>Drop Down</i>
1	Active	09/15/11	Historic Site Approval	On-site structures may be eligible for Historic Register causing project delay.	Front-End Planning	Schedule
2	Active	09/15/11	Change in pavement section and/or type	Traffic studies may result in a change in pavement section and/or type resulting in a project cost increase.	Detail Engineering	Cost
3	Active	09/15/11	Replace culvert over Wandering Creek	If required by the hydraulic study, the culvert at Wandering Creek may need to be replaced resulting in a project cost increase.	Front-End Planning	Cost
4	Active	09/15/11	Additional wetland mitigation	Widening to the north will impact a 10- to 15-foot-wide strip of existing Class III wetlands along the east half of the upgrade, causing an increase in project cost.	Detail Engineering	Cost
5	Active	09/15/11	Delay in request for proposal	The city may not meet its RFP development schedule, resulting in a project delay.	Procurement	Schedule



# Appropriate Levels of Risk Management





# Appropriate Levels of Risk Management

LEVEL 2 - DETERMINISTIC						
Item #	Brief Risk Description	Category of Impact	Pre-Mitigated Risk Ranking			
			Most Likely Impact	Most Likely Probability	Risk Mean Value (Dollars)	Overall Risk Ranking
			Qualitative Value	Qualitative Value		
<i>Auto</i>	<i>Auto</i>	<i>Auto</i>	<i>Drop Down (Selection Required)</i>	<i>Drop Down (Selection Required)</i>	<i>Auto</i>	<i>Auto</i>
1	Historic Site Approval	Schedule	Medium	Medium	\$657,000	Med
2	Change in pavement section and/or type	Cost	High	Low	\$540,000	Med
3	Replace culvert over Wandering Creek	Cost	High	High	\$1,620,000	High
4	Additional wetland mitigation	Cost	Medium	Very Low	\$67,500	Low
5	Delay in request for proposal	Schedule	Medium	Low	\$328,500	Med



# Appropriate Levels of Risk Management

ITER Project Example

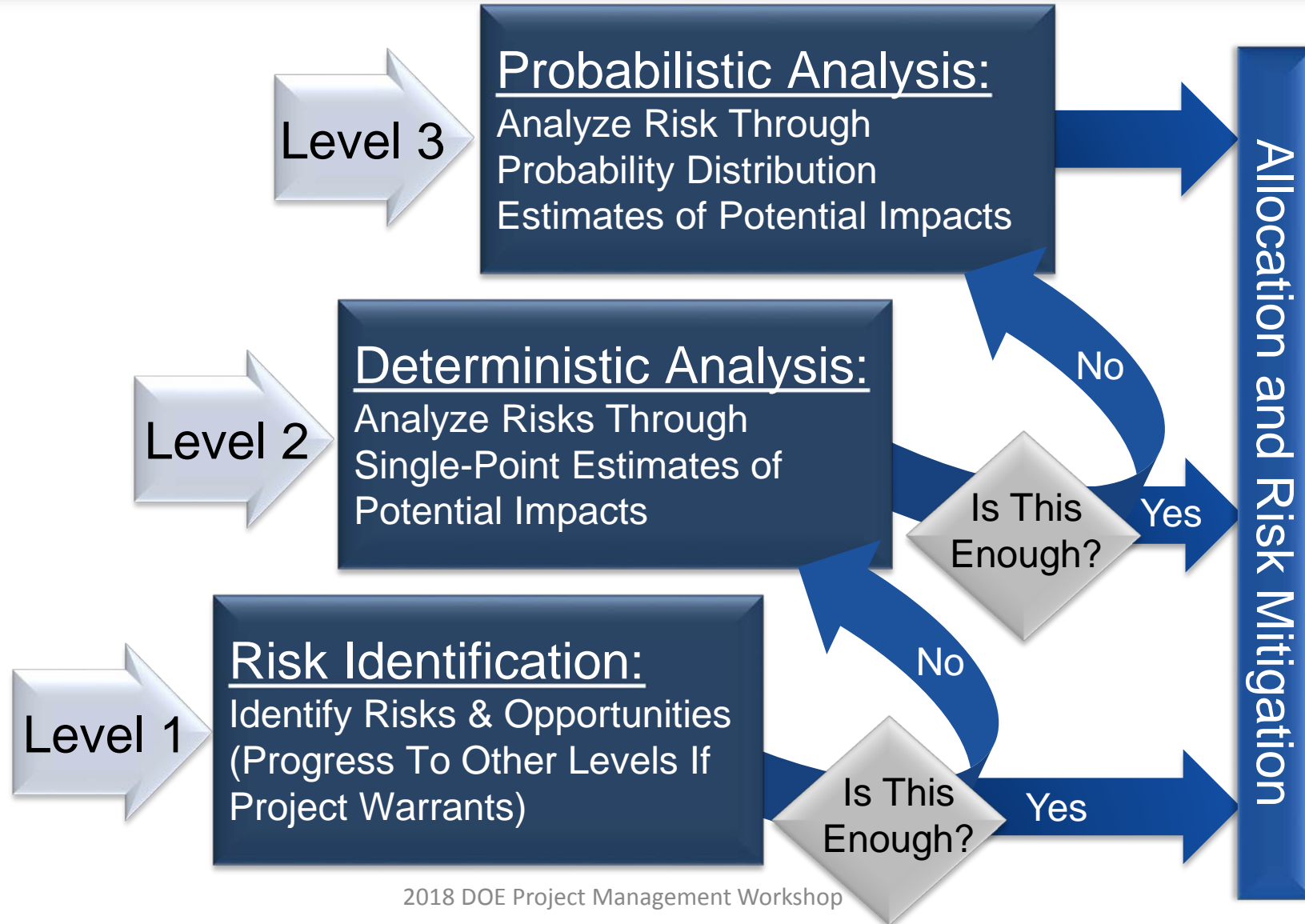
Likelihood of Occurrence	CONSEQUENCES			INCREASING PROBABILITY								
	ES&H	LCLS II Example		Definition of Probability		Occurs	Probability Rating	Score				
		Score	Approx. %	Description	Score			Approx. %	1	2	3	
Imminent	ES&H	1	≤1%	Rare	4	50% < P < 80%	5	5	20	45	80	125
Very Unlikely		2	>1% - 10%	Unlikely - Not	3	30% < P < 50%	4	4	16	36	64	100
Likely		3	>10% - 30%	Possible	2	10% < P < 30%	3	3	12	27	48	75
		4	> 30%	Very likely	1	P > 30%	2	2	8	18	32	50
INCREASING IMPACT	Massive Effect	Concept	Definition of Impact	Score	Severity	Description of Impact	Score	Description of Impact				
		1	Negligible	≤ \$250K	5	€ 20M ≤ C						
		2	Low	≤ \$3M	4	€ 5M ≤ C < € 20M						
	Major Effect	not beyond 6 months	Moderate	≤ \$10M or che	3	€ 2M ≤ C < € 5M						
		3	High	> \$10M	2	€ 0.5M ≤ C < € 2M						
		Schedule Impact	2	€ 0.5M ≤ C < € 2M								
	Localized Effect	New design beyond 12 months	Negligible	Any Change to	5	C < € 0.5M						
		2	Low	Any Change to	4	12 months ≤ S						
		3	Moderate	Any Change to	3	6 months ≤ S < 12 months						
	Minor Effect	New design some R&D	Negligible	Negligible Imp	3	3 months ≤ S < 6 months						
		2	1 - 2 months	Minimal impact	2	1 week ≤ S < 3 months						
		1	High	changes in	1	S < 1 week						
Slight Effect	New design no R&D	Moderate	Moderate Imp	5	Will not be able to operate in DT phase							
	4	< 1 month	Any change in	4	Operational regime will be reduced							
	3	High	changes to	3	System specifications will not be met							
				2	Performance affected but system specifications maintained							

Overall Consequence Level = P \* ((S + I) / 3)

Score = Probability Rating x (Max of Schedule Impact Rating or Cost Impact Rating)<sup>2</sup>



# Appropriate Levels of Risk Management





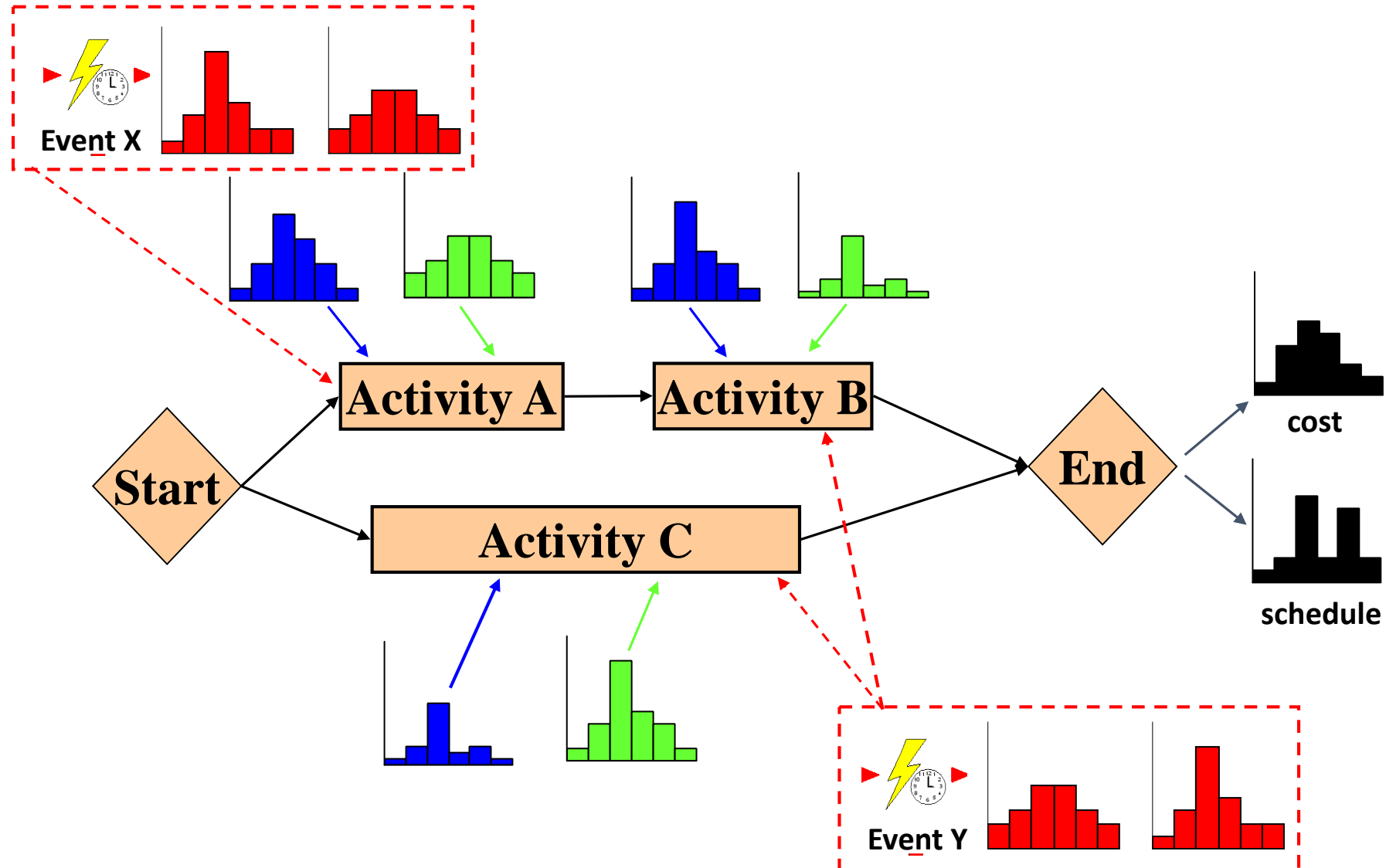


# Appropriate Levels of Risk Management

LEVEL 3 - PROBABILISTIC								
Item #	Brief Risk Description	Category of Impact	Cost (Dollars)			Schedule (Days)		
			Best Case	Most Likely	Worst Case	Best Case	Most Likely	Worst Case
Auto	Auto	Auto	Manual	Auto (Manual Override)	Manual	Manual	Auto (Manual Override)	Manual
1	Historic Site Approval	Schedule	-	-	-	40	82	120
2	Change in pavement section and/or type	Cost	\$250,000	\$540,000	\$750,000	-	-	-
3	Replace culvert over Wandering Creek	Cost	\$950,000	\$1,620,000	\$1,800,000	-	-	-
4	Additional wetland mitigation	Cost	\$40,000	\$67,500	\$90,000	-	-	-
5	Delay in request for proposal	Schedule	-	-	-	50	82	90

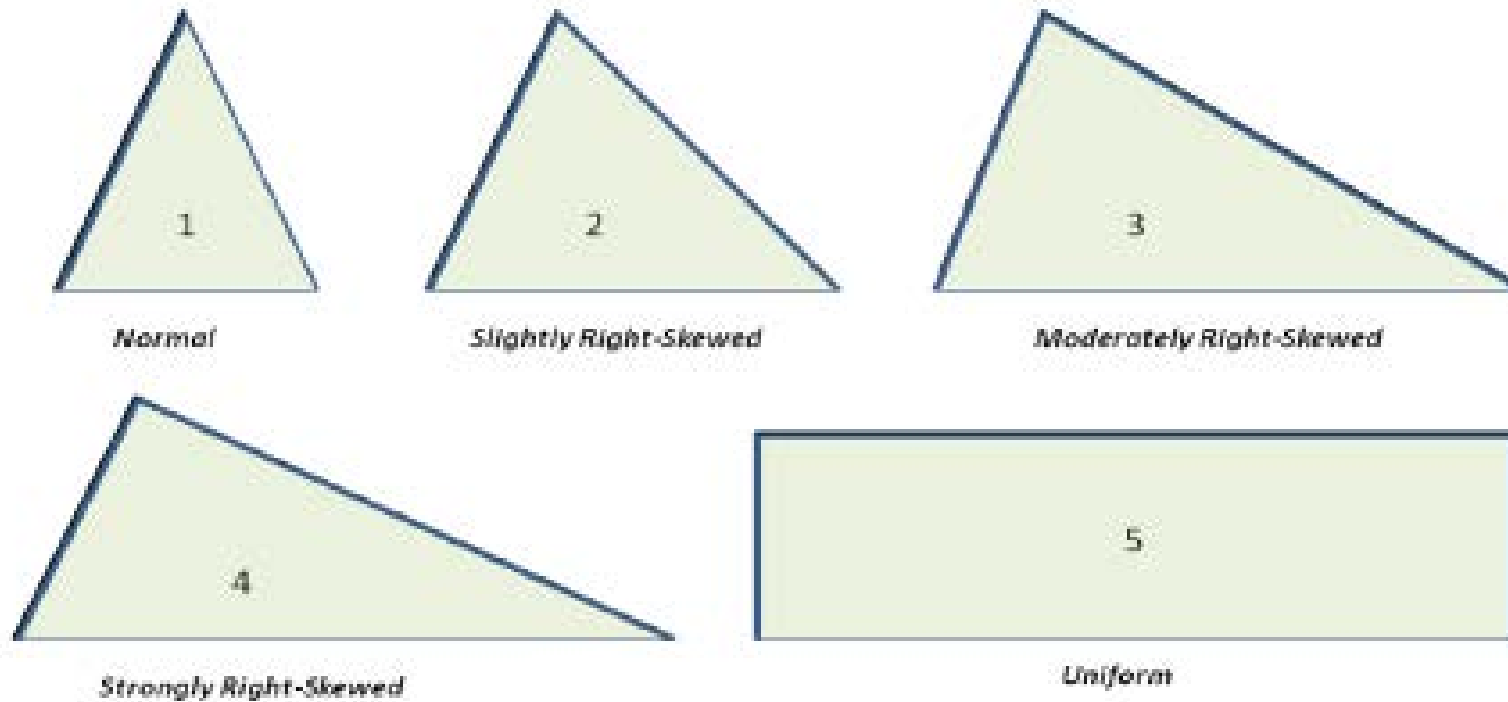


# Appropriate Levels of Risk Management





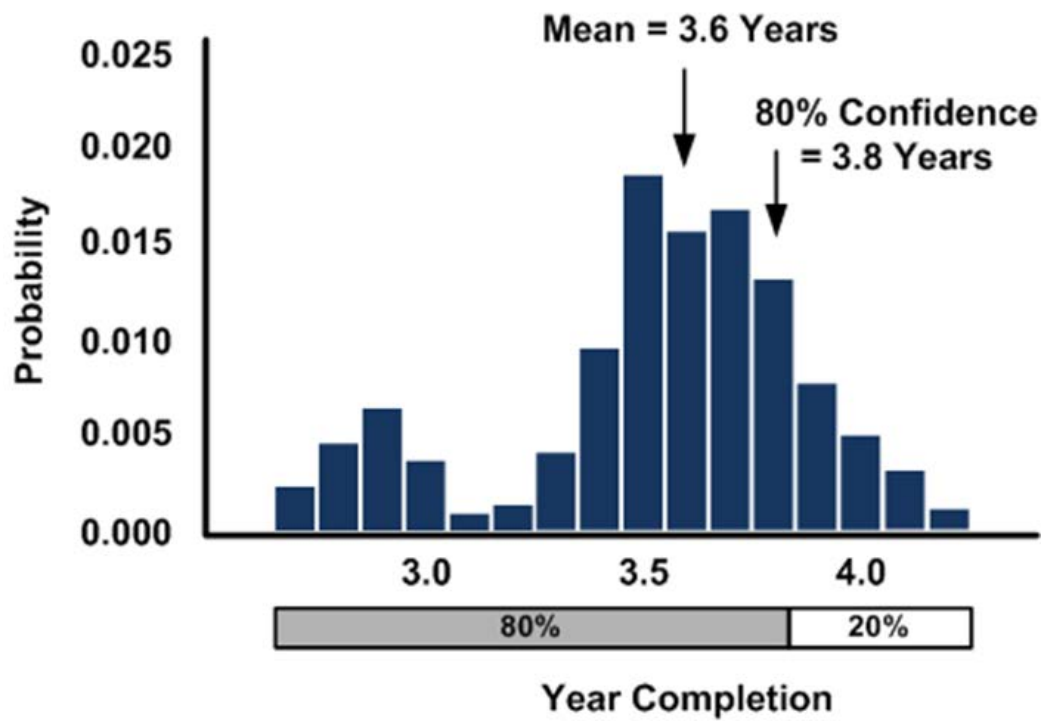
# Appropriate Levels of Risk Management



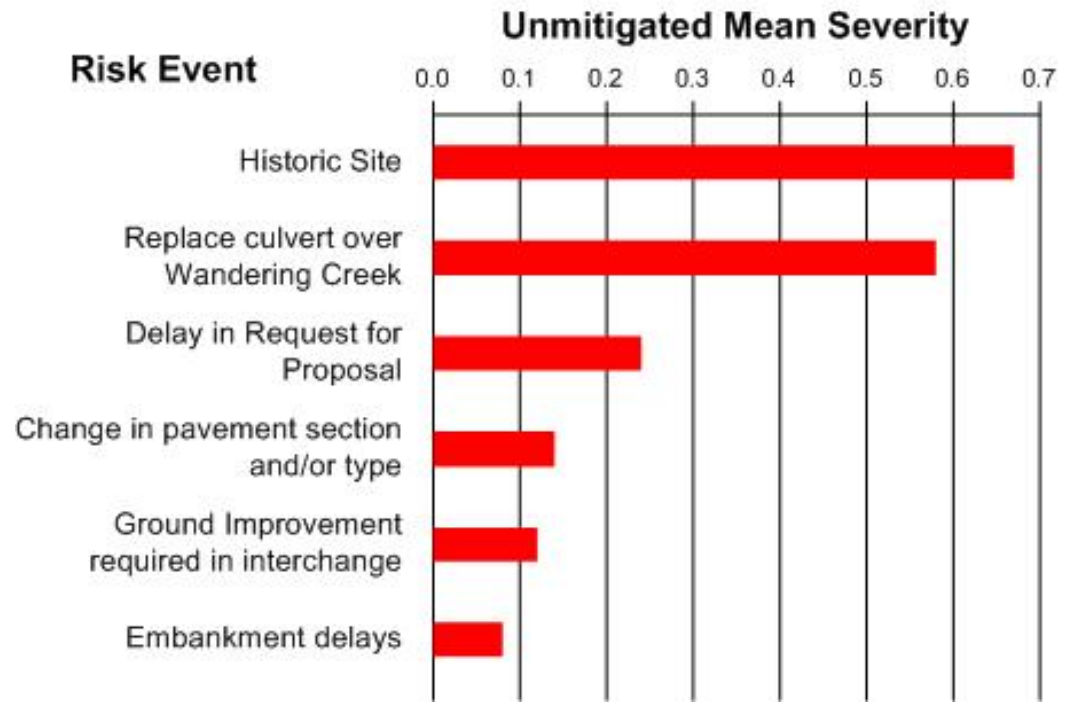


# Appropriate Levels of Risk Management

### Distribution for Project Schedule (Year)



### Tornado Diagram





# Learning Objectives

- ✓ Choose appropriate levels of risk management
- Describe biases that can impact risk assessments
- Apply results of risk analysis appropriately



# Biases that Can Impact Risk Assessments

## Risk Assessments

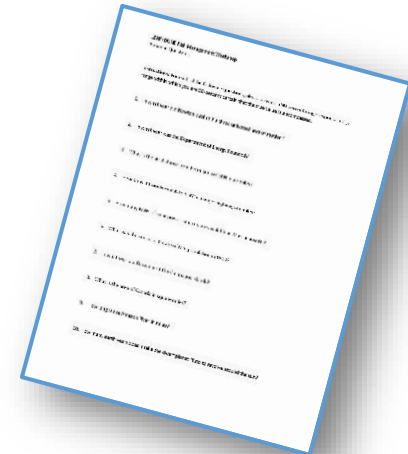
- One-of-a-kind projects rely on subjective risk assessments
- To make good assessments we must be aware of our biases
  - Estimating uncertainty
  - Representativeness
  - Availability



# Biases that Can Impact Risk Assessments

## A General Knowledge Exam

- I will distribute an exam of 10 questions
- Please answer each question using a RANGE of values (not a single value)
- Select the RANGE such that you are 90% certain that the correct answer lies with your specified RANGE





# Biases that Can Impact Risk Assessments

## What did Capen find?

- A large number of technical people have little idea of what to do with uncertainty
- Having no good quantitative idea of uncertainty, there is an almost universal tendency to underestimate it
- People tend to be prouder of their answers than they should be
- Even when people are told that ranges tend to be small, they cannot guess large





# Biases that Can Impact Risk Assessments

## Representativeness

### True or False

“People with a Ph.D. are more likely to read the New York Times than persons with only a high school education”



# Biases that Can Impact Risk Assessments

## Representativeness

There is a woman sitting next to you in the cafe who is reading the *New York Times*...

Which is likely true:

- a) She has a Ph.D.
- b) She doesn't have a college degree

Base Case Frequency



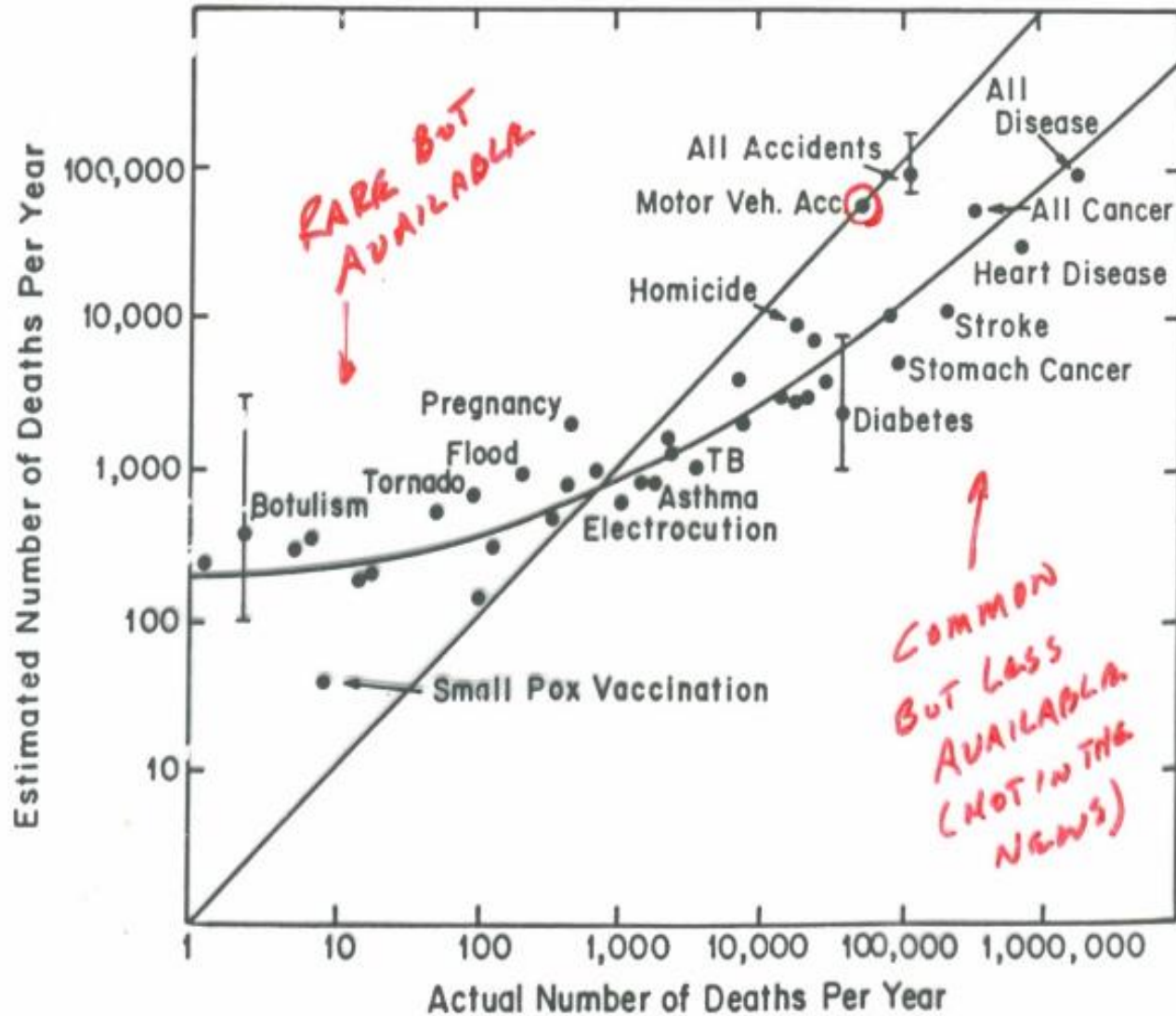
# Biases that Can Impact Risk Assessments

## Availability

- Human judgment tends to over-estimate rare events that are more available or memorable
- and under-estimate rare events that are less available or memorable



# Biases that Can Impact Risk Assessments





# Biases that Can Impact Risk Assessments

## **Availability** – *another example*

- How many seven letter words in the English language contain an “n” in the sixth position?

— — — — — n —

How many words \_\_\_\_\_



# Biases that Can Impact Risk Assessments

## **Availability** – *another example*

- How many seven letter words in the English language contain an “n” in the sixth position?

— — — — i n g

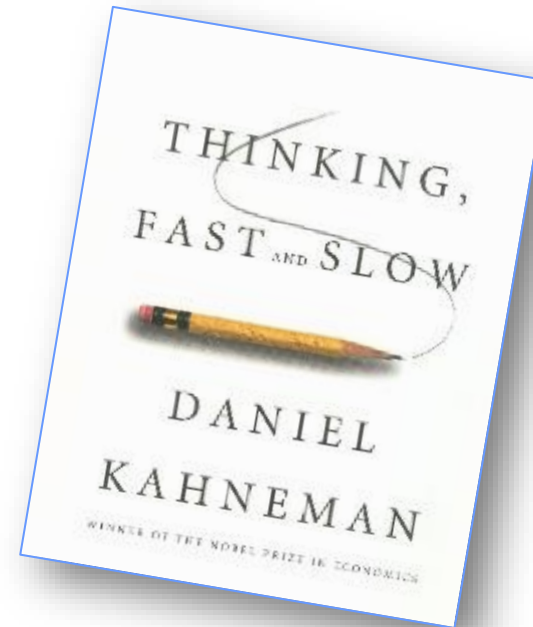
How many words \_\_\_\_\_



# Biases that Can Impact Risk Assessments

## Risk Assessments

- Estimating Uncertainty
  - Almanac Quiz
- Representativeness
  - Ignoring base case frequencies
- Availability
  - \_\_\_\_\_ing





# Learning Objectives

- ✓ Choose appropriate levels of risk management
- ✓ Describe biases that can impact risk assessments
- Apply results of risk analysis appropriately





# Appropriate Application of Risk Analysis

- Use appropriate “levels” of risk analysis
- Be cognizant of biases when making assessments
- Focus on the relative impact of risks
- Be cautious of applying Monte Carlo results for contingency without a thorough management assessment
- Create a risk management process that is appropriate for decisions being made



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