

A stylized graphic of a bridge structure, showing the main span and supporting cables, rendered in white and light blue against a dark blue background.

Program Risk Management

San Francisco-Oakland Bay Bridge Replacement Program

**1st International Conference on Transportation
Construction Management**

Orlando, FL

February 11, 2009

**Jon Tapping, California Department of Transportation
Rein Lemberg, CALTROP Corporation**



Preview of Coming Attractions

- **The San Francisco – Oakland Bay Bridge**

- The Project
- Risk Management Challenges
- Risk Management Planning



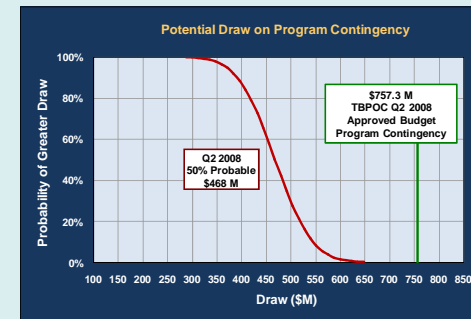
- **Quantitative Risk Management**

- Not rocket science
- “KISS”



- **Applications**

- Budget Analysis
- Schedule Risk Management
- Risk-based Decision-making





San Francisco - Oakland Bay Bridge

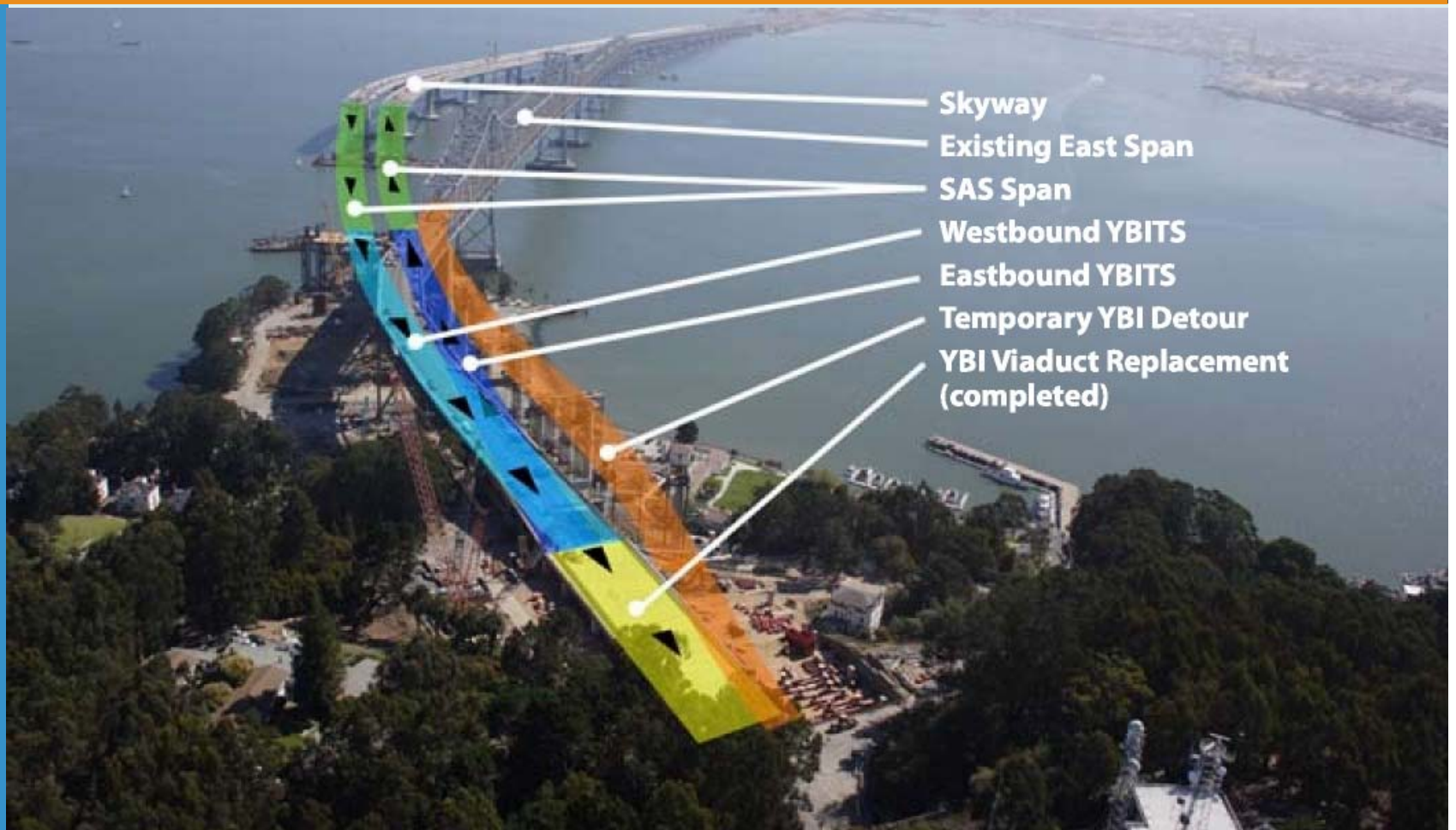
Largest construction project (\$6 billion)

**Extremely difficult
engineering and construction
challenges**

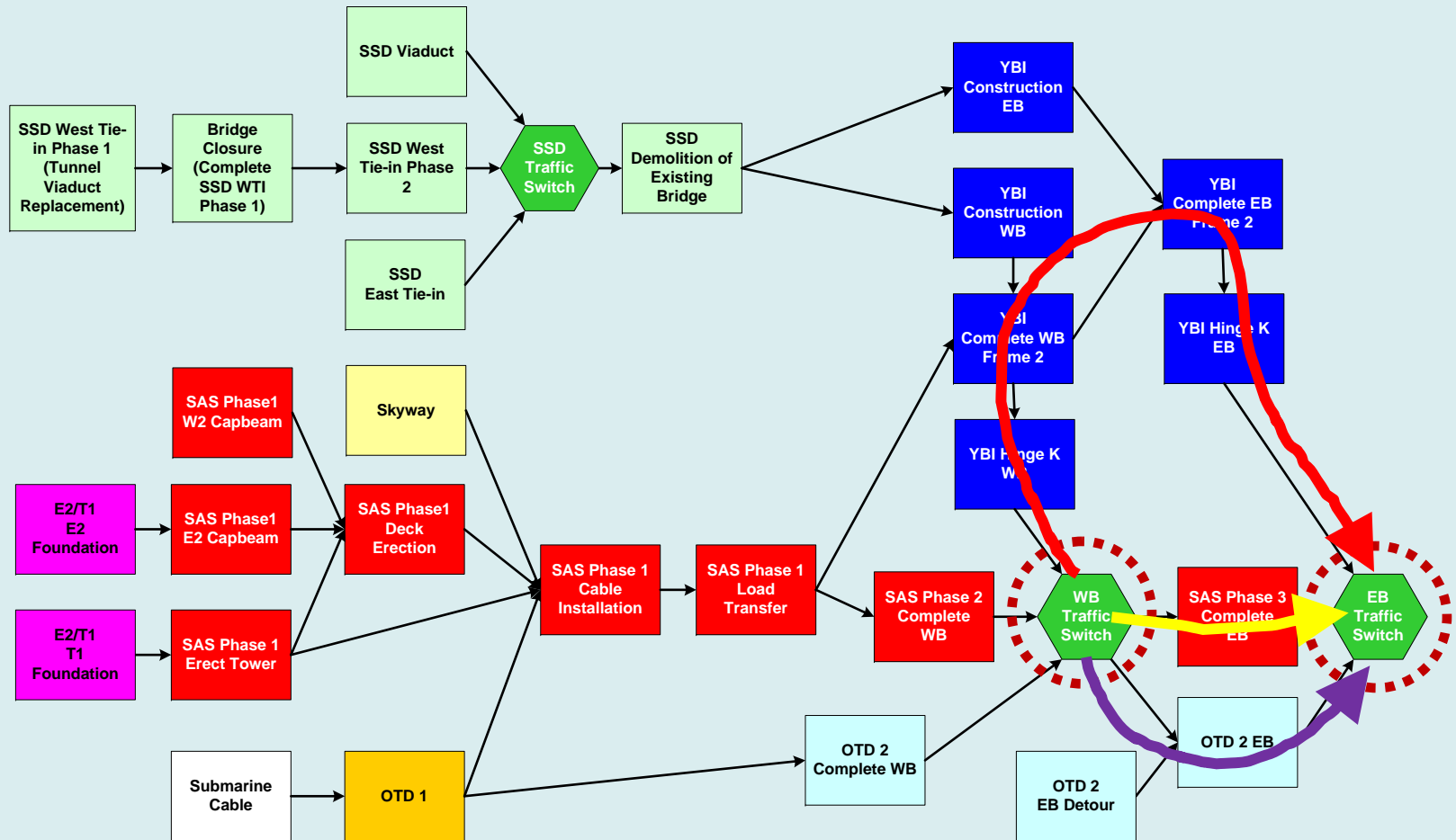




Multiple Construction Sequences



Multiple **Interdependent** Contracts



AB 144 Legislation

“comprehensive risk management”

**Oversight
Committee**

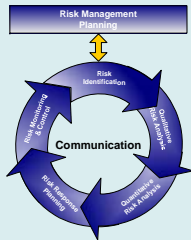


“assess adequacy of reserves”

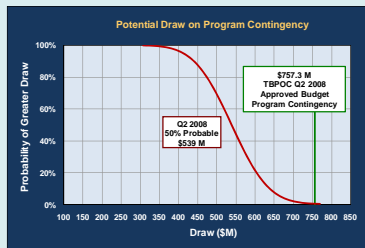


Risk Management Challenges

Multi-Agency Environment

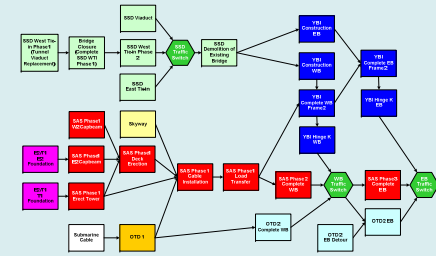


Implement Risk Management Processes



Quantitative Cost & Schedule Risk Analysis

000531	Design/Fab/Transport to China Shear Leg Barge	
SAS R30A	Delay in Barge Fabrication & Transport	20%
000891	Install Shear Leg on Barge & Transport to SF	
SAS R30	Barge Crane Delayed	50%
000901	Commission Shear Leg Crane Barge	
SAS R40	Shear Leg Barge Crane Commissioning is extend...	30%



Multiple Interdependent Contracts

Volume of Risk Data

Multiple overlapping spreadsheets titled 'Corridor Program - RISK REGISTER' showing detailed risk data for various projects.



Planning Risk Management

Risk
Manag
Proce

TOLL BRIDGE SEISMIC RETROFIT PROGRAM

Program
Risk Management Plan

July 2006

ibilities

Framework

Rep



ntation
S



Risk Management Organization

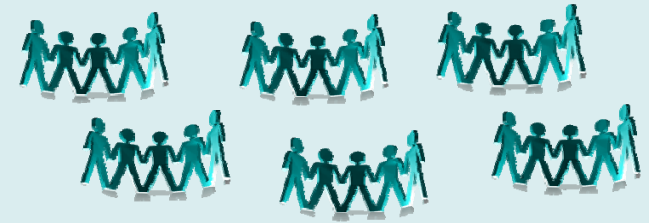
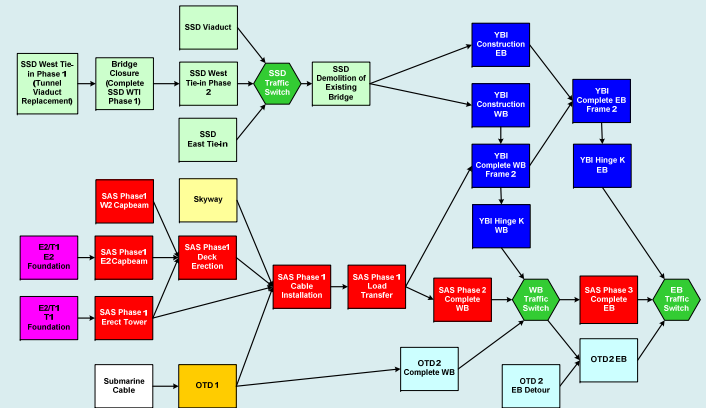
Multi-functional Team



Agency
Reps

Project Management
Functional Depts.
Construction
Risk Management

Risk Management 101
for everyone

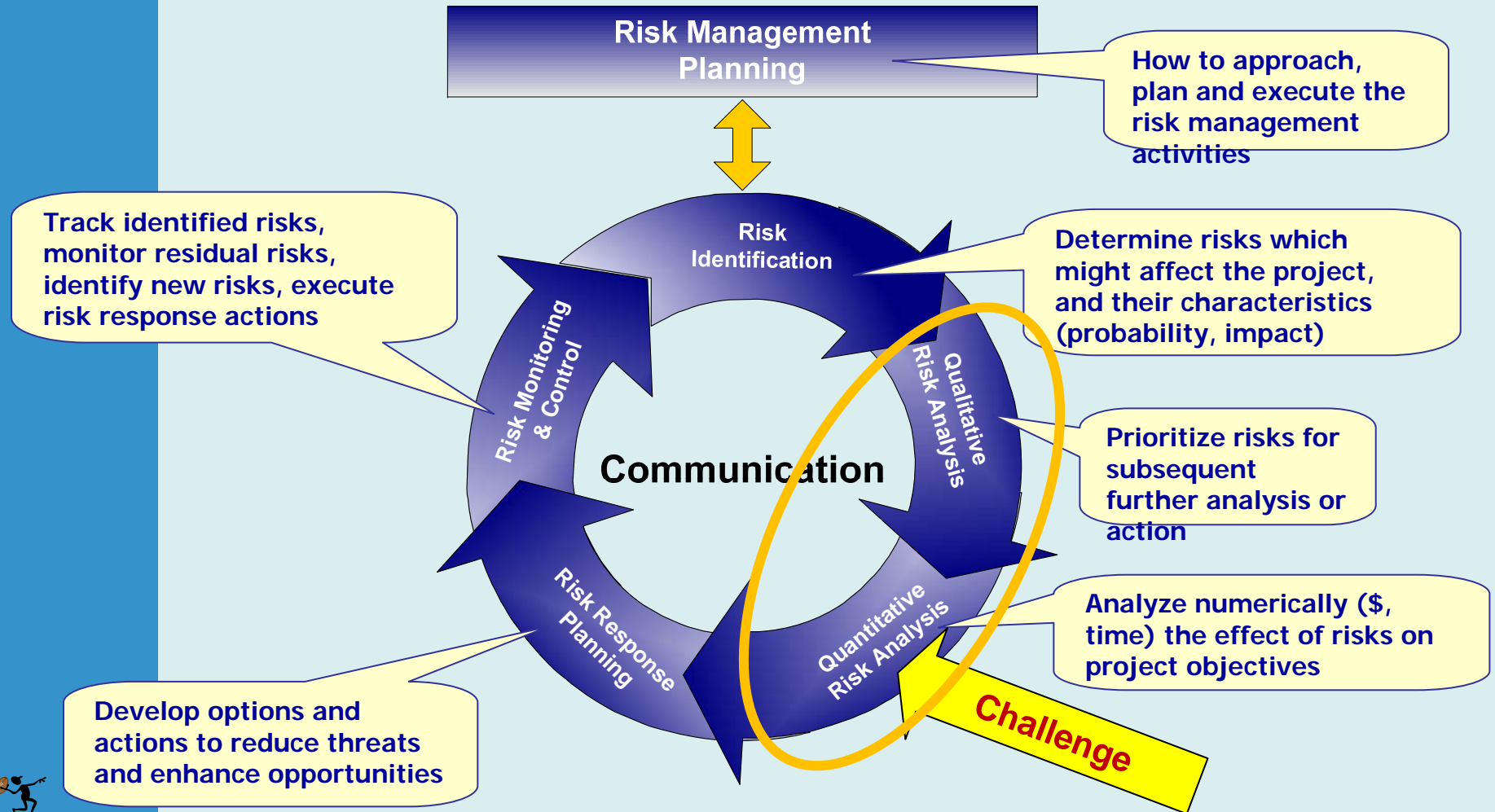


Team for each Contract



Program Team

Risk Management Cycle





Why Quantitative Risk Analysis?

- On SFOBB we must “**assess the adequacy of reserves**”.
 - We need to calculate the cost probability distribution
- Quantitative Risk Analysis allows us to:
 - Calculate the probability distributions for total cost and total time
 - Evaluate the probability of meeting cost and completion targets, and the adequacy of the Program Contingency.



Quantitative Risk Management

Beta Distribution

Lognormal Distribution

“Bell curve”

Standard Deviation

? ? ? ? ? ?



Qualitative Assessment

Risk = Probability **X** Impact

Low

High

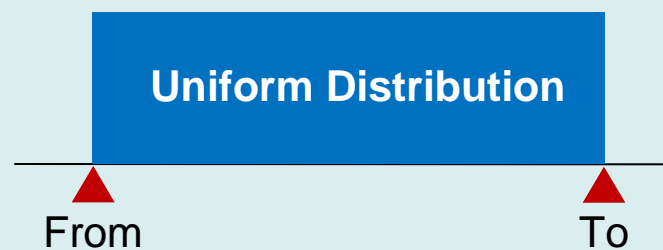
Probability Level	5					25
	4		8			
	3					
	2			X	8	
	1	X				
		1	2	3	4	5
		Impact Level				



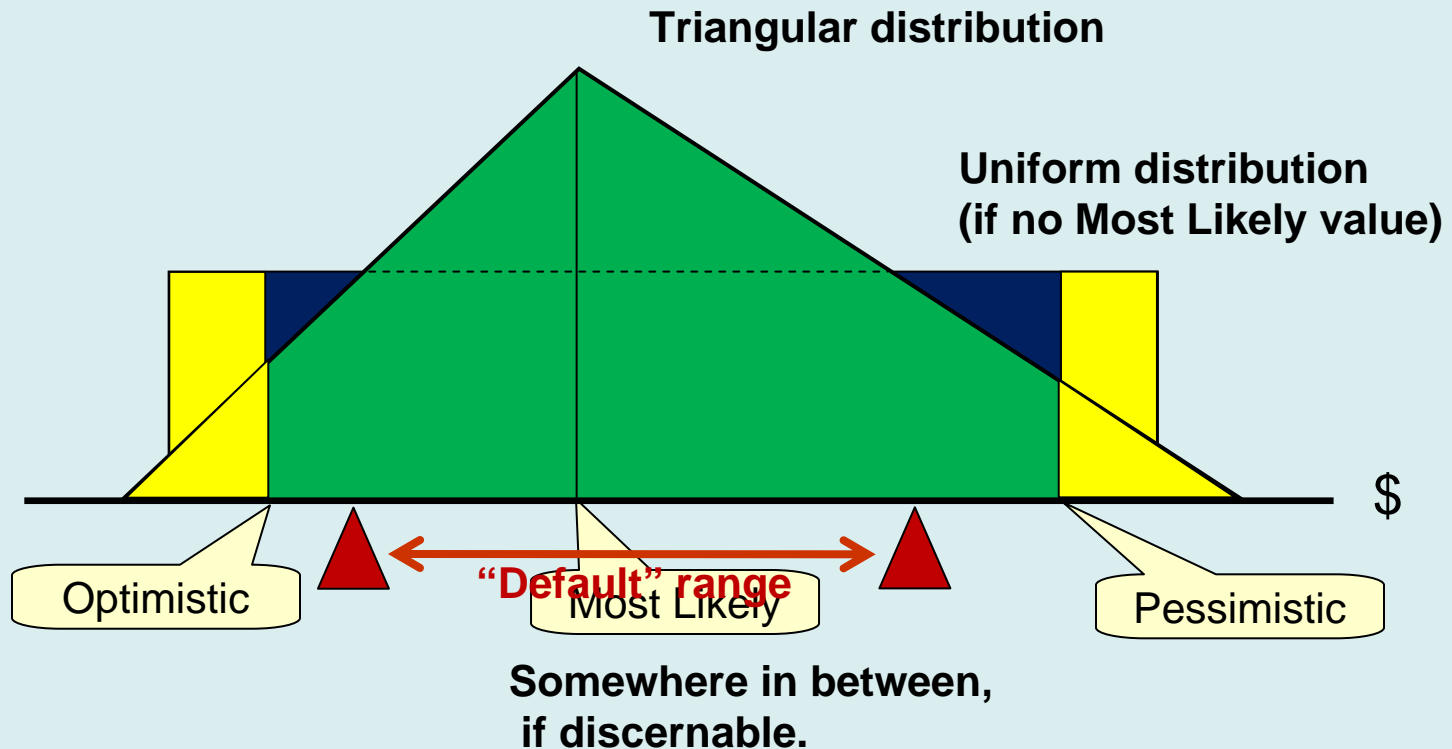
From "Words" to Quantitative Ranges

	Cost (\$)		Delay (days)		Probability (%)	
	From	To	From	To	From	To
Very Low	0	5,000,000	0	30	1	9
Low						
Moderate						
High						
Very High						

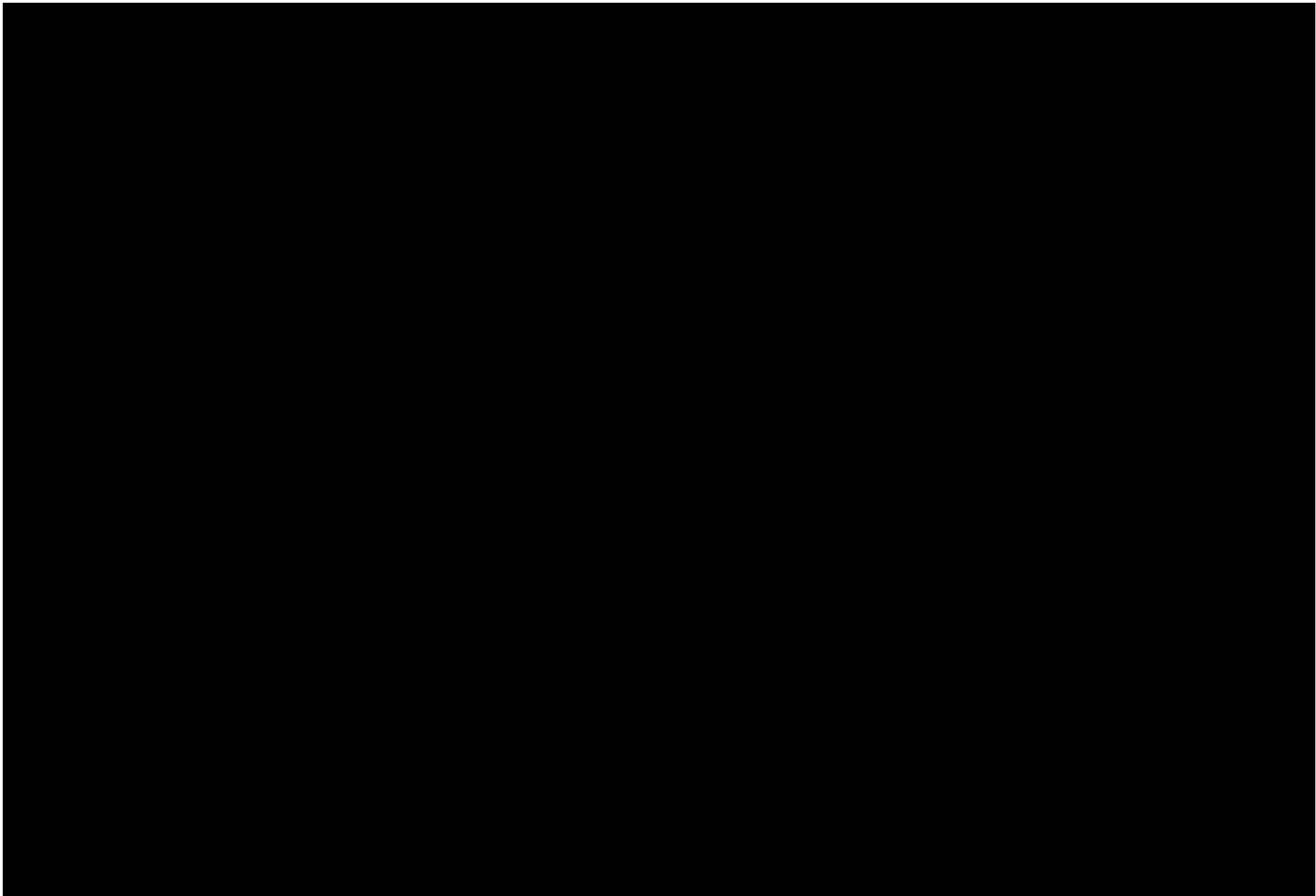
"Default" Ranges – different for each project



Applying the "Default" Ranges



This occurs in the **Risk Management Information System**

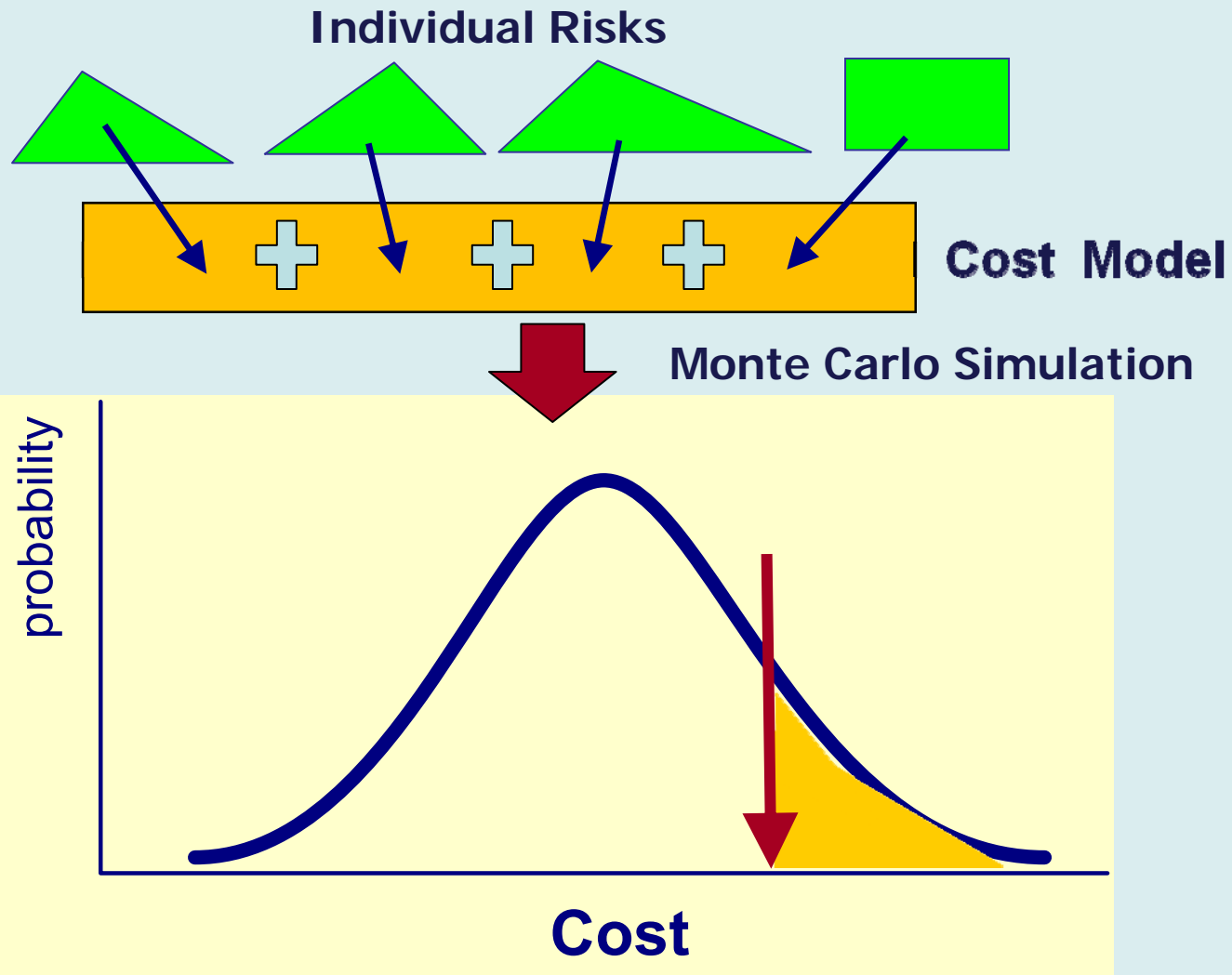


Ready

00:07

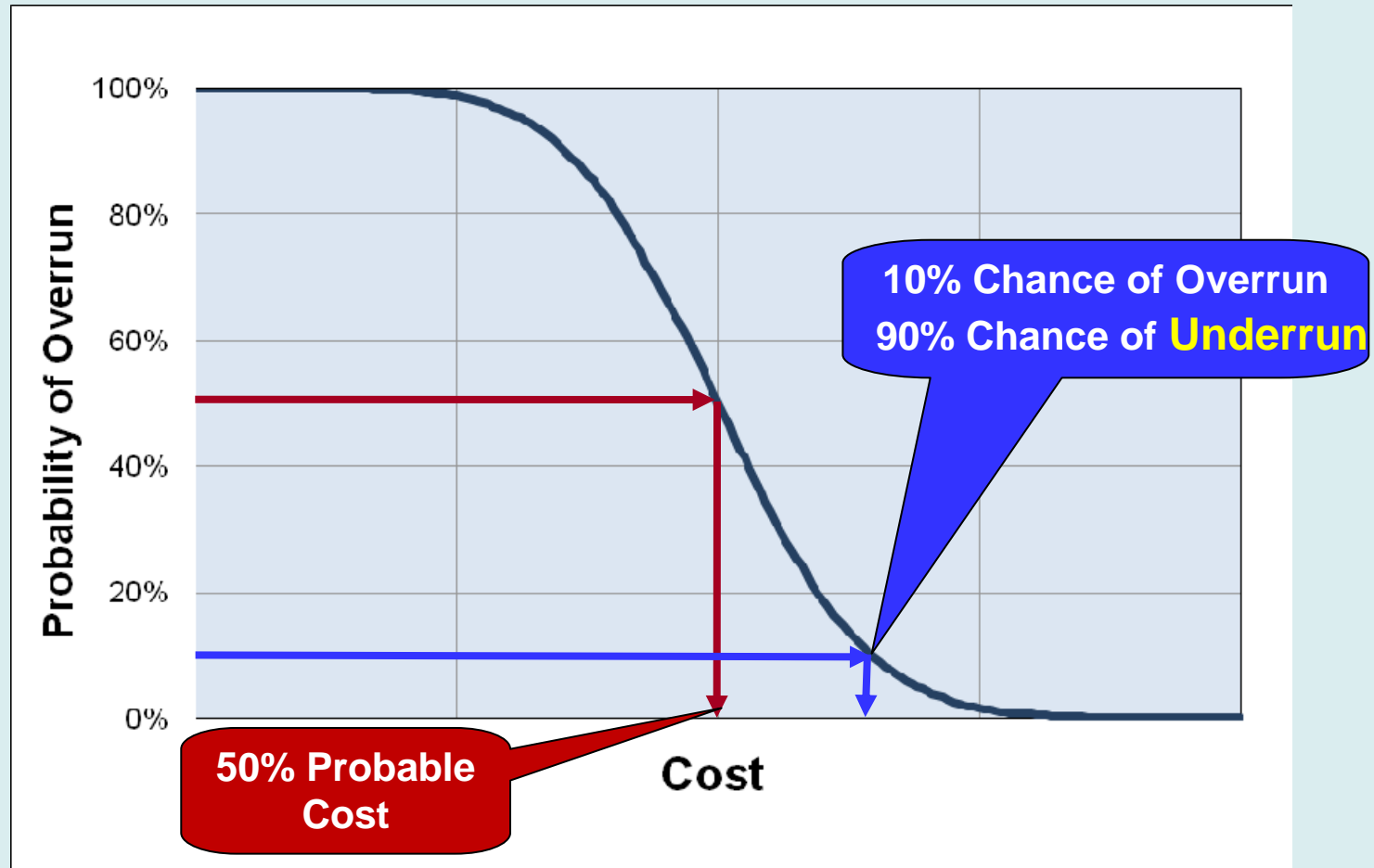


Putting it all together...



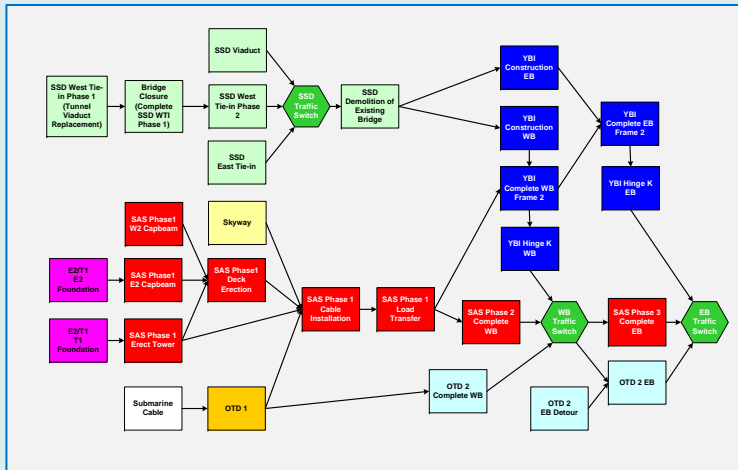


A "readable" Probability Curve



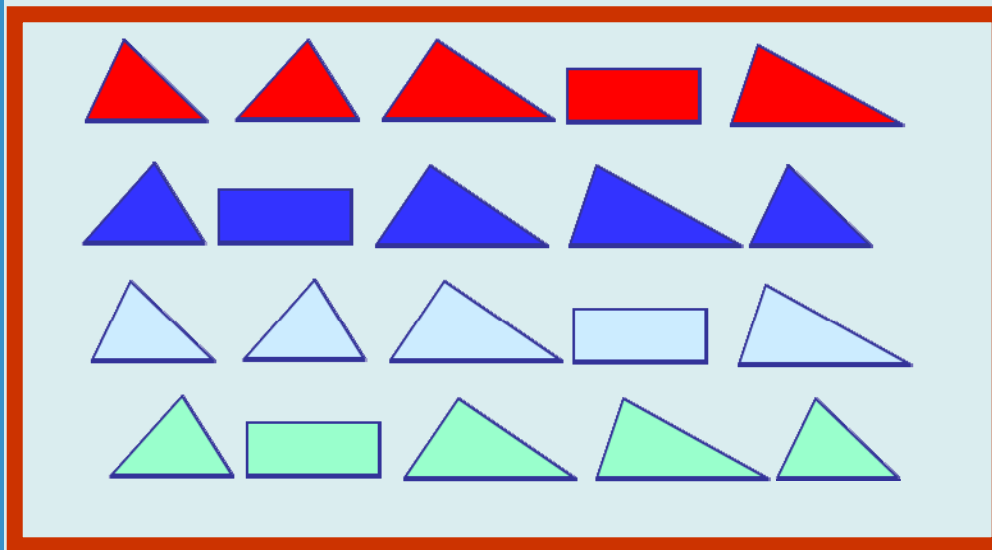


Portfolio of Contracts



Multiple Contracts
– a Portfolio

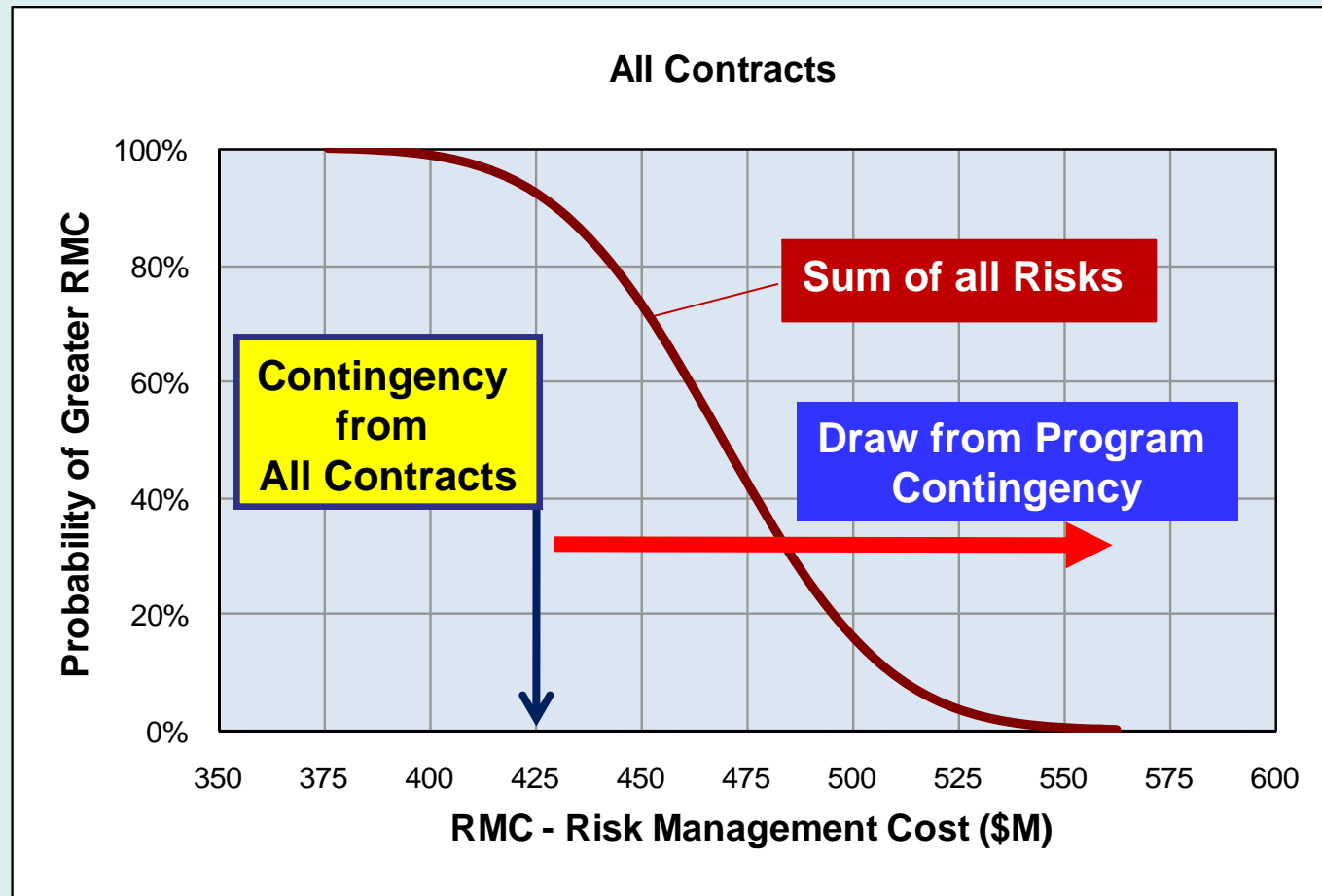
Contract	Remaining Contingency
D	130
E	170
Total	425



Σ Risks 
Each Contract
has Risks

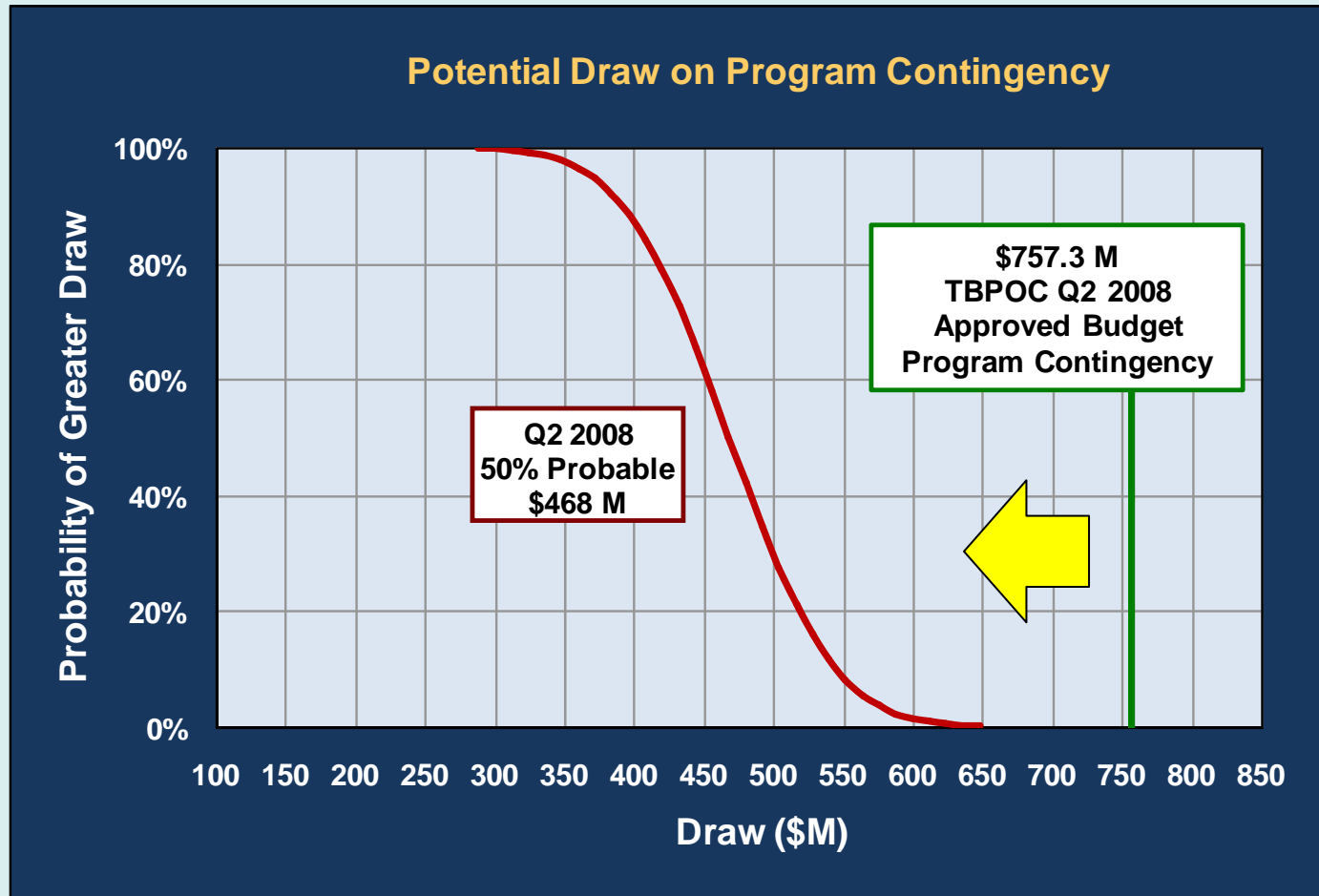


Portfolio View of Contracts



Our "Bottom Line"

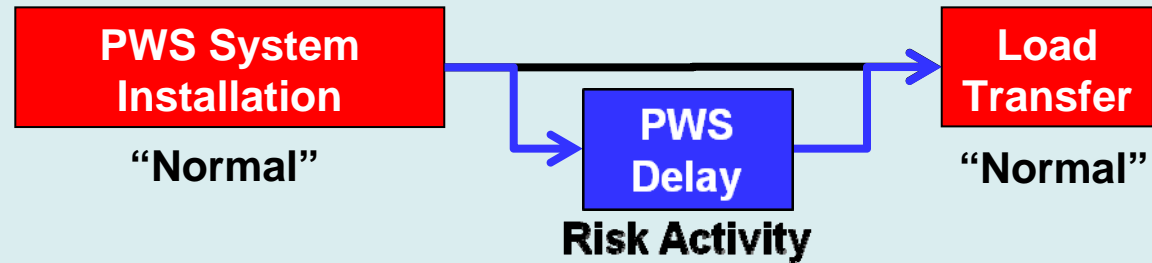
"Adequacy of Program Reserves"





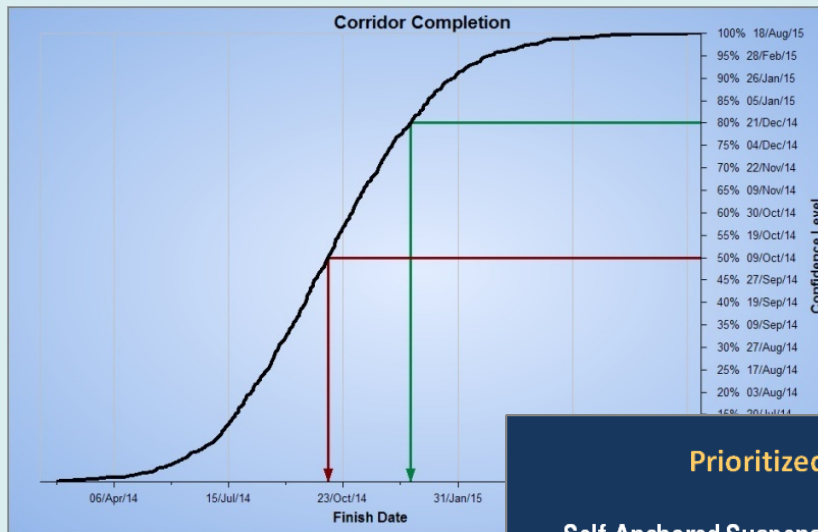
Schedule Risk Analysis

Activity ID	RISK	Activity Description	Orig Dur	2011												2012											
				M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D				
SAS Cable System																											
000831	N	Erect Cable System Temporary Works	167																								
000341	N	PWS System Installation	232																								
000351	N	Load Transfer Cable to Deck Sect.	52																								
000941	N	Complete Cable system & Remove Temp. Works	230																								





Schedule Risk Analysis



Probability Distributions For Milestones

Tornado Diagram (Top Risks)

Prioritized Corridor Schedule Opportunities and Risks

Self-Anchored Suspension (SAS) Tower and Deck Fabrication

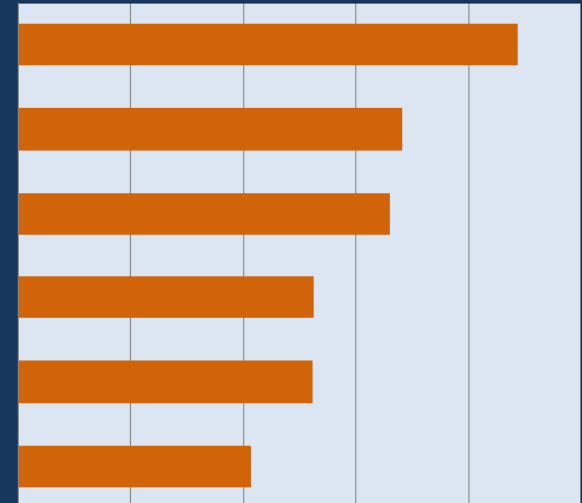
SAS Cable Installation

SAS Barge Crane Procurement and Delivery

Corridor Electrical/Mechanical Systems Integration

SAS Tower Erection

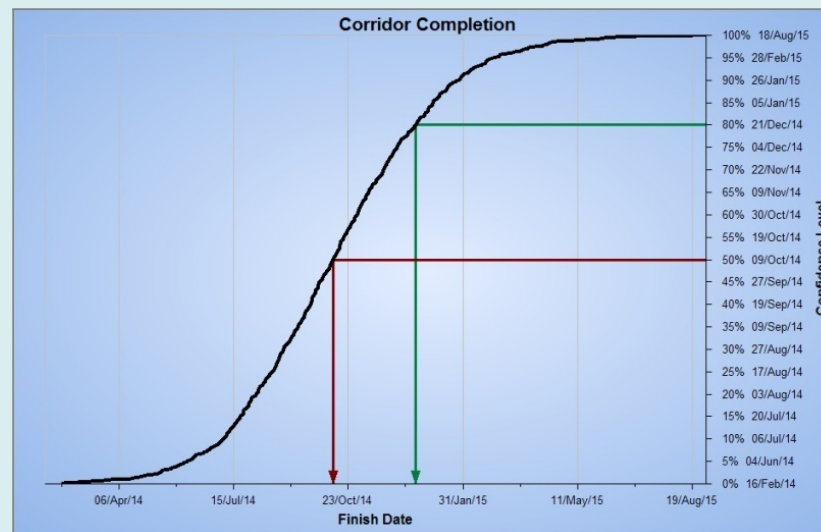
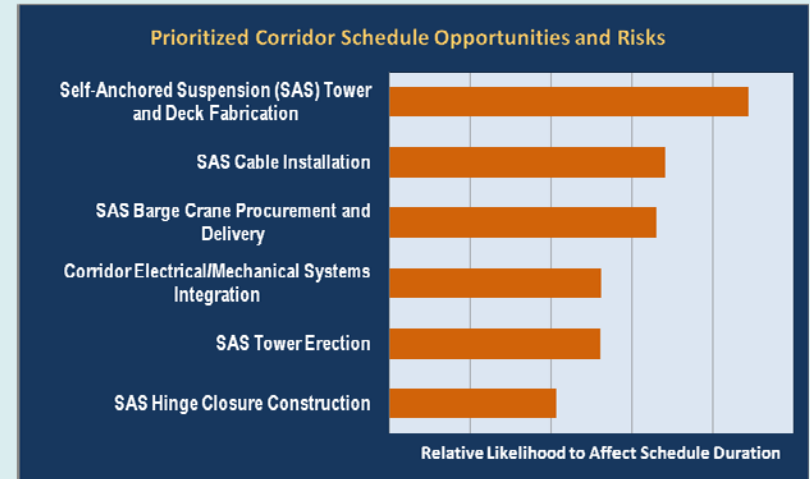
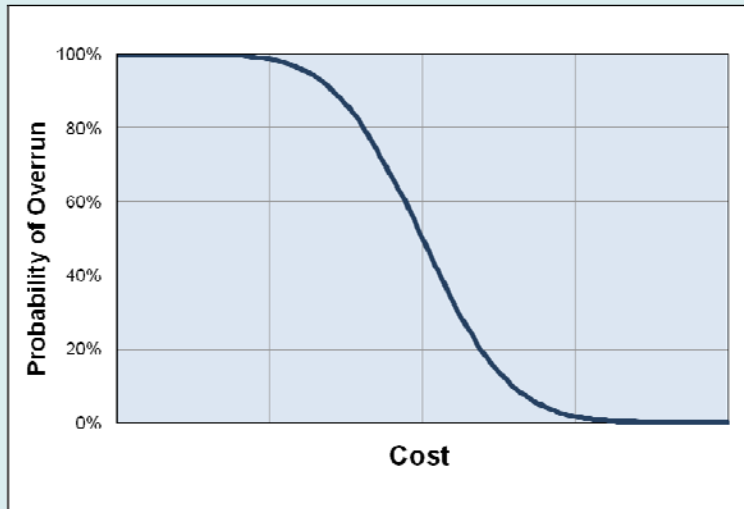
SAS Hinge Closure Construction



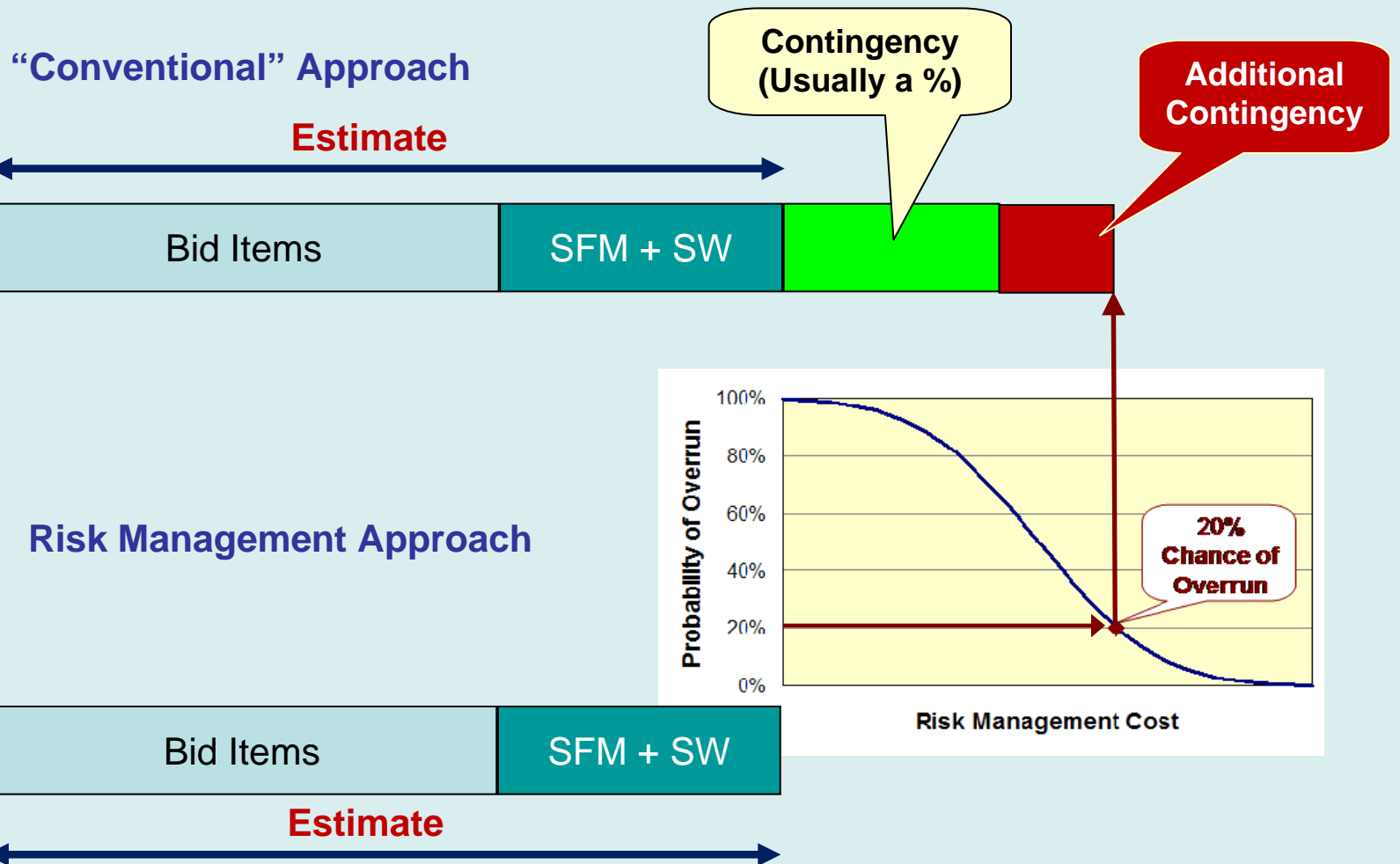
Relative Likelihood to Affect Schedule Duration



How do we apply these?



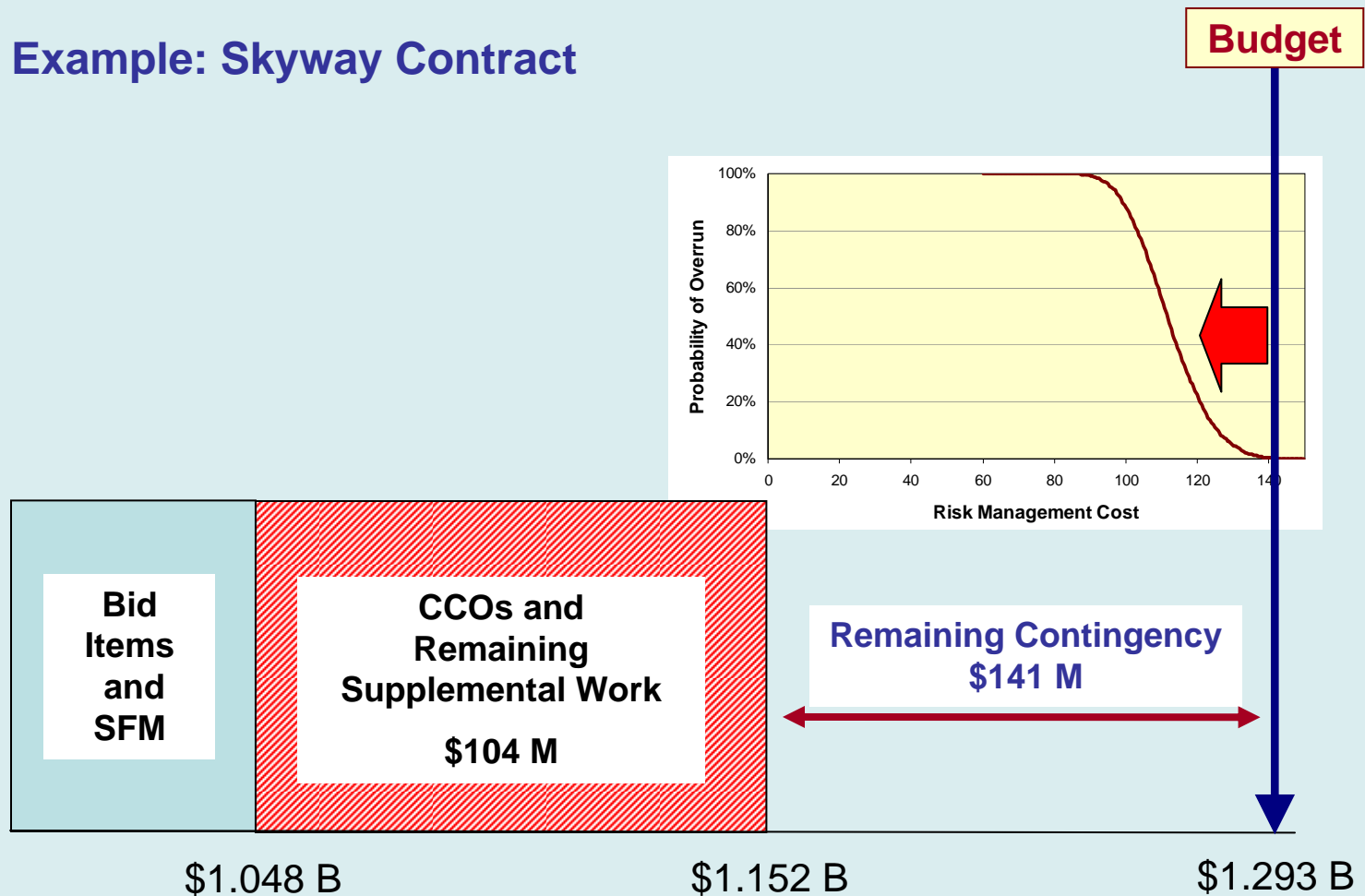
Contingency Validation in Design Phase





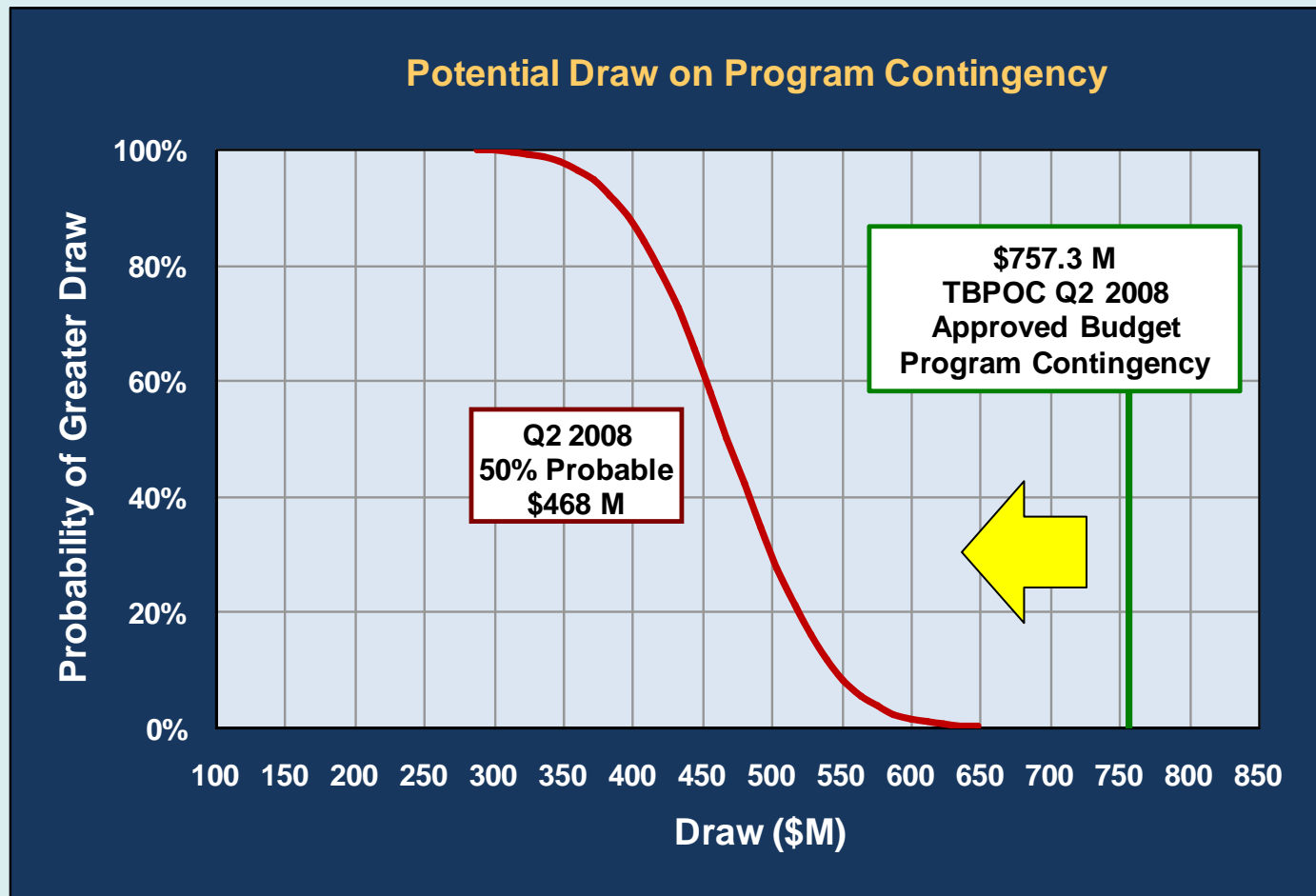
For Budget Analysis During Construction

Example: Skyway Contract



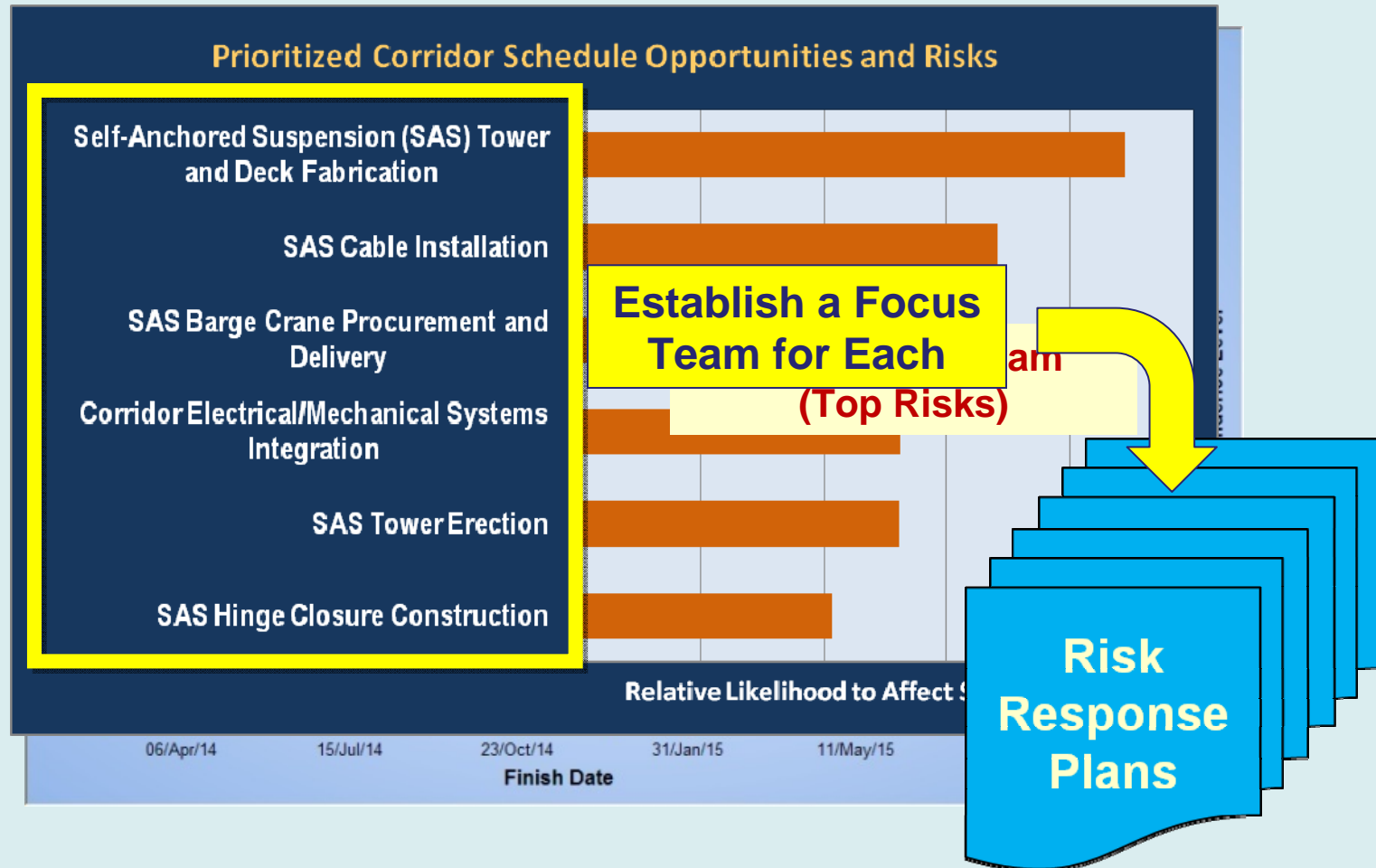
Our "Bottom Line"

"Adequacy of Program Reserves"





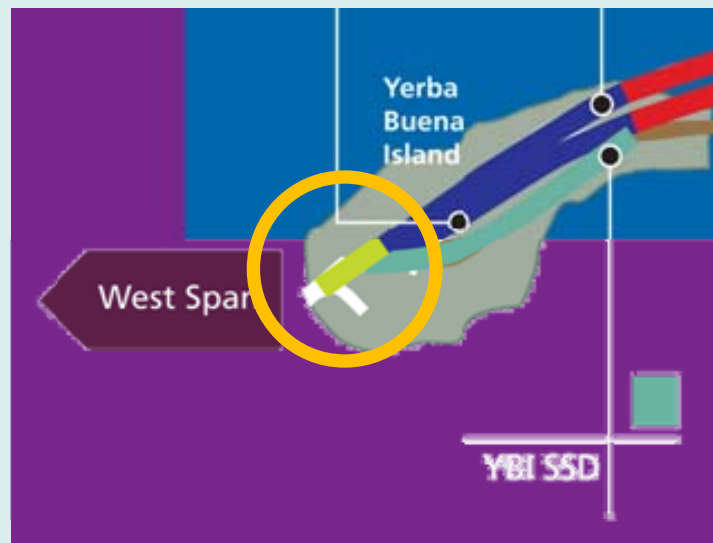
Schedule Risk Analysis Output





Risk-based Decision-making

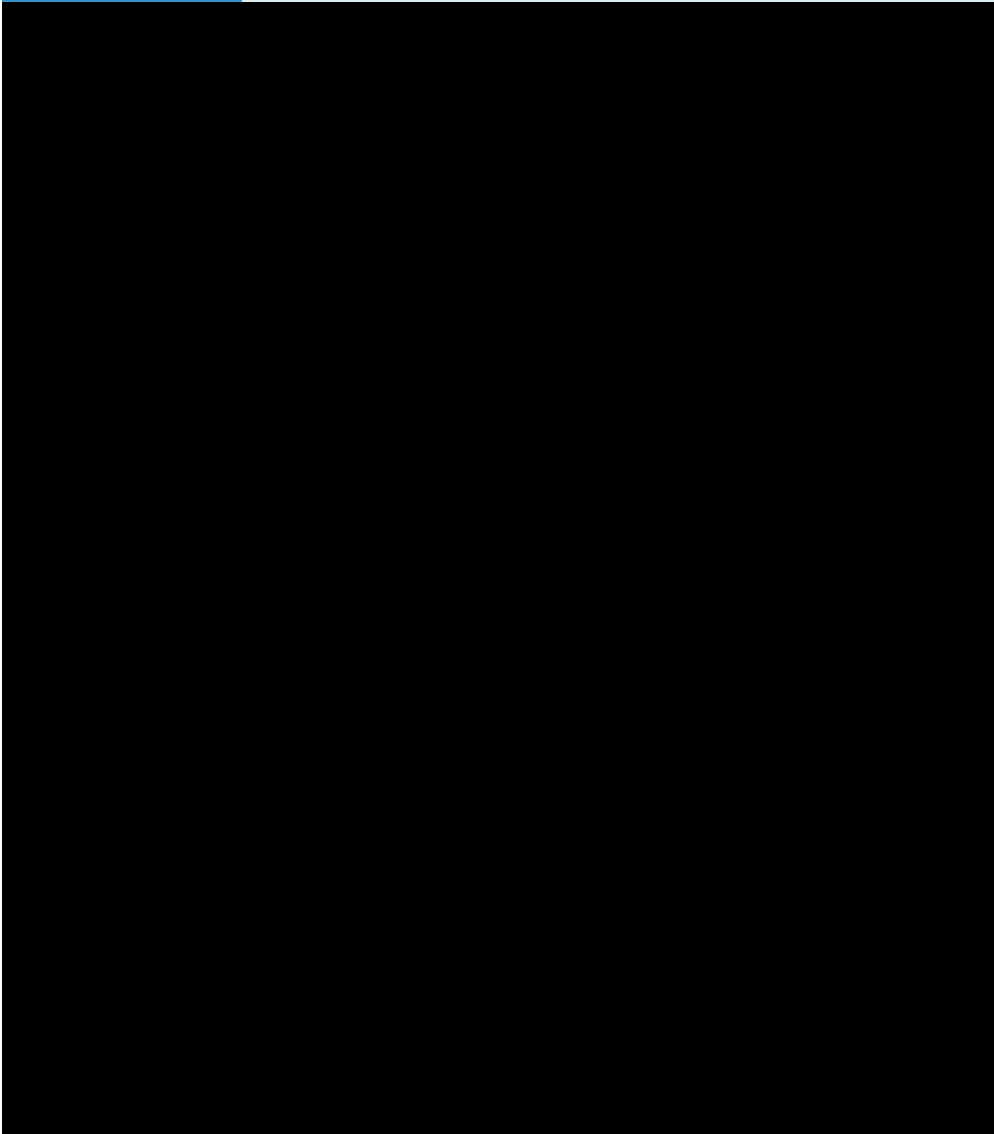
- Retrofit or Replace Viaduct from Tunnel?



Decision: Replace viaduct

Accomplished during a 3-day weekend closure!

- Risk Issues:
 - Old structure, unclear as-builts
 - Possible hidden problems
 - Effect on public traffic





How has it worked out?

Risk Management evolved at a steady and sustainable pace (“baby steps”) – gained broad acceptance.



Program/Project Management

Risk Management

RM has become an integral component of program and project management.



Partner Agencies find transparency refreshing...involved in RM activities



Oversight Committee considers RM results in budget forecasting and strategic decision-making

Discussion?



Project Risk Management

Contact Information:

Jon Tapping
jon_tapping@dot.ca.gov
(510) 385-6856

Rein Lemberg
rlemberg@caltrop.com
(510) 410-4344