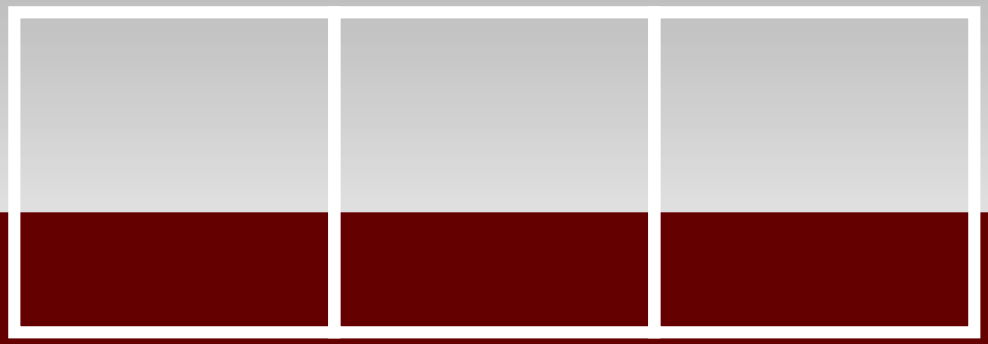
"Principles for Assessing Financial Risks In Capital Construction Projects"

R.L. "Rick" Rye

Northwest Construction Consumers Council
Seattle, WA

March 26, 2009

Hill International



Introduction

- Risk is the chance that something will happen changing the expected outcome of the project.
  - consequence that are undesirable
  - loss, damage, injuries, failures
  - loss of opportunity (for achieving the project goals and objectives)

Introduction

- Risk types having an effect on the projects
  - safety risks
  - professional liabilities
  - environmental risks
  - contract risks
  - builders risks
  - economic risks
  - security risks
- Financial and cost change
  - manage at best

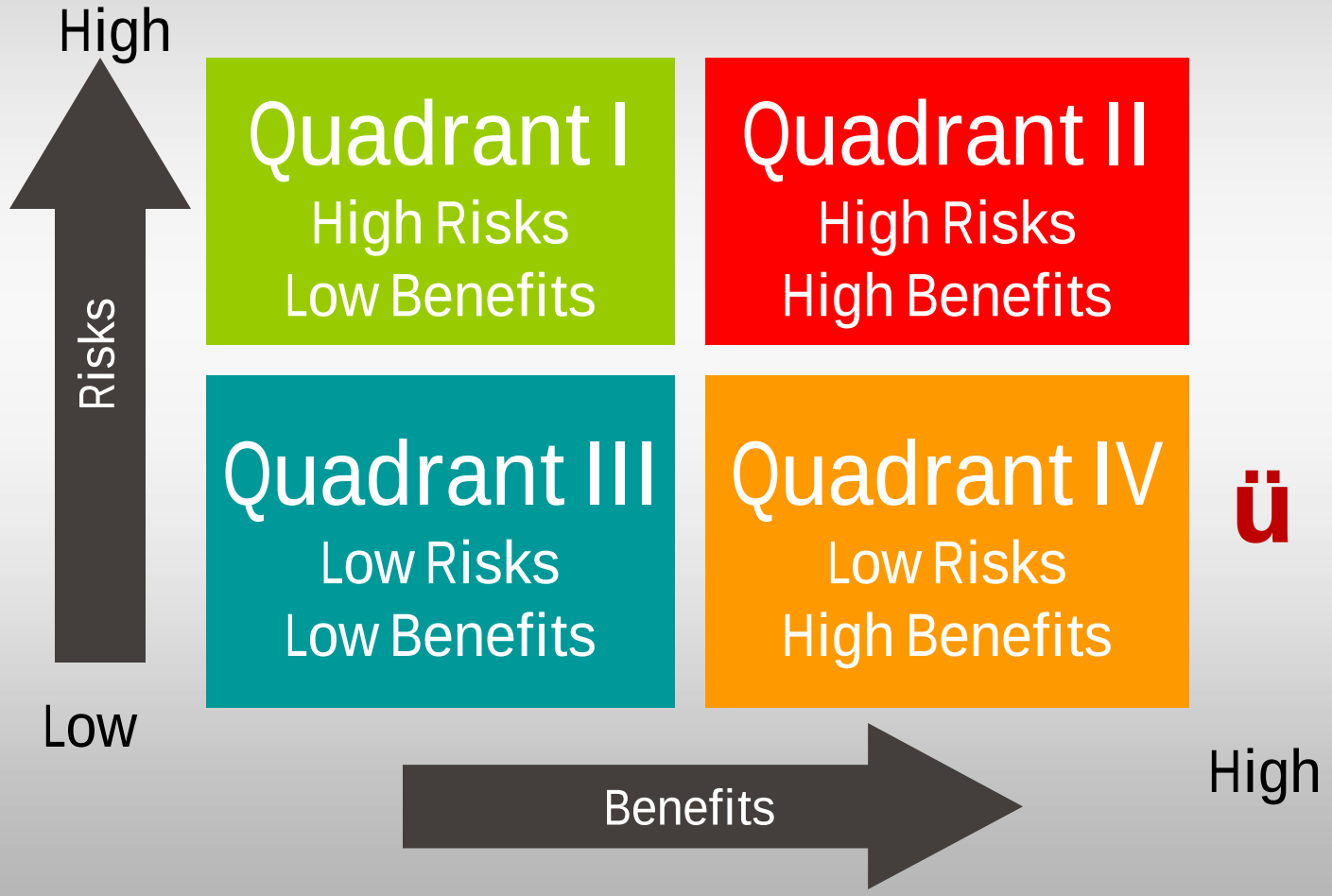
ü time

ü cost

ü scope definition

Introduction

Risk and benefits opportunities assessment matrix



Introduction

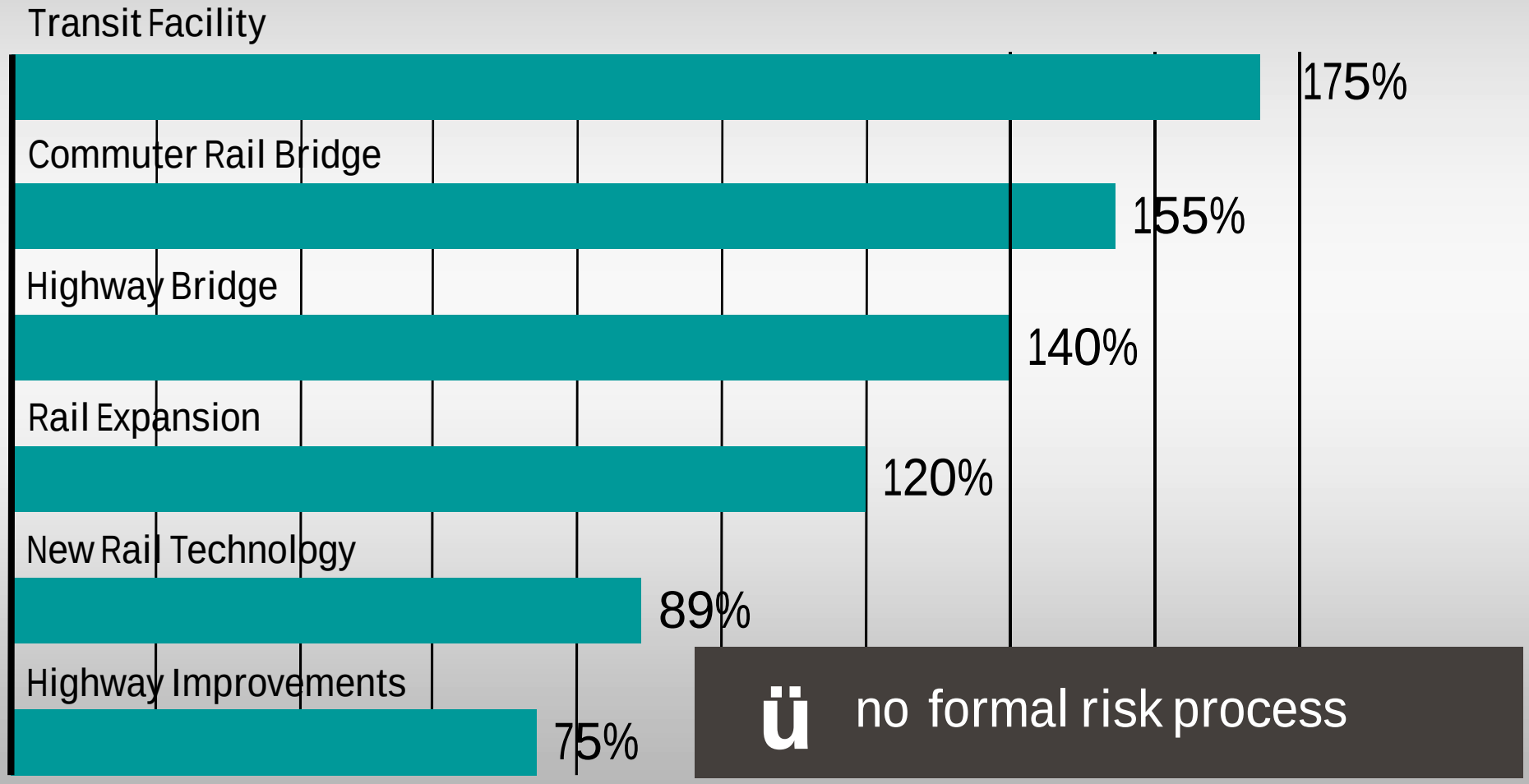
- Survey and study of project performance

ü 40 projects range from $300 million to $8.2 billion

- Technical capacity exist
- Abundance of processes, plans, tools, and techniques (more available and use today than ever)
- Striking poor performance

Introduction

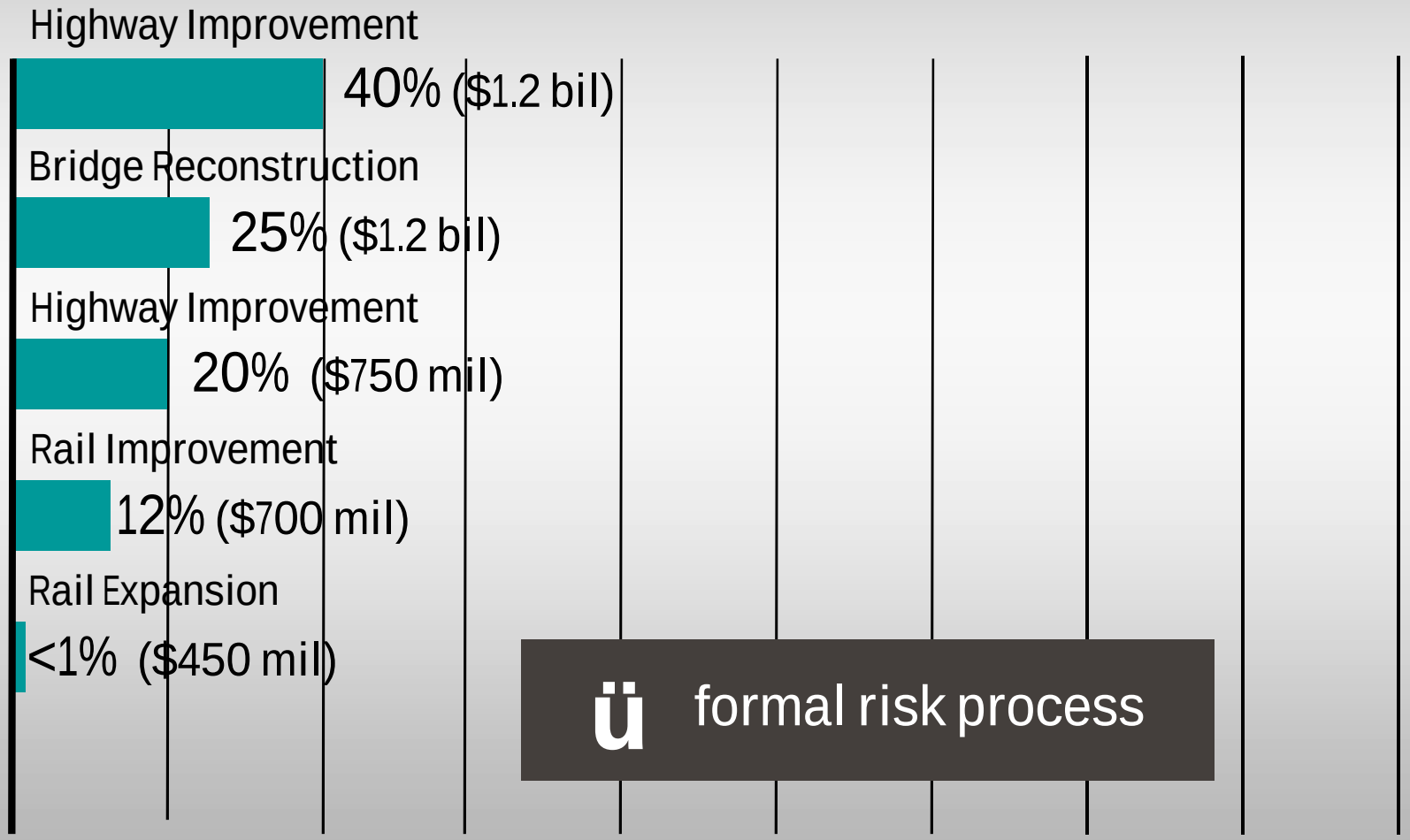
Capital construction budget overruns for U.S. mega-projects



Percent (%) of construction cost overrun above the original baseline budget.

Introduction

Capital construction budget overruns for U.S. mega-projects



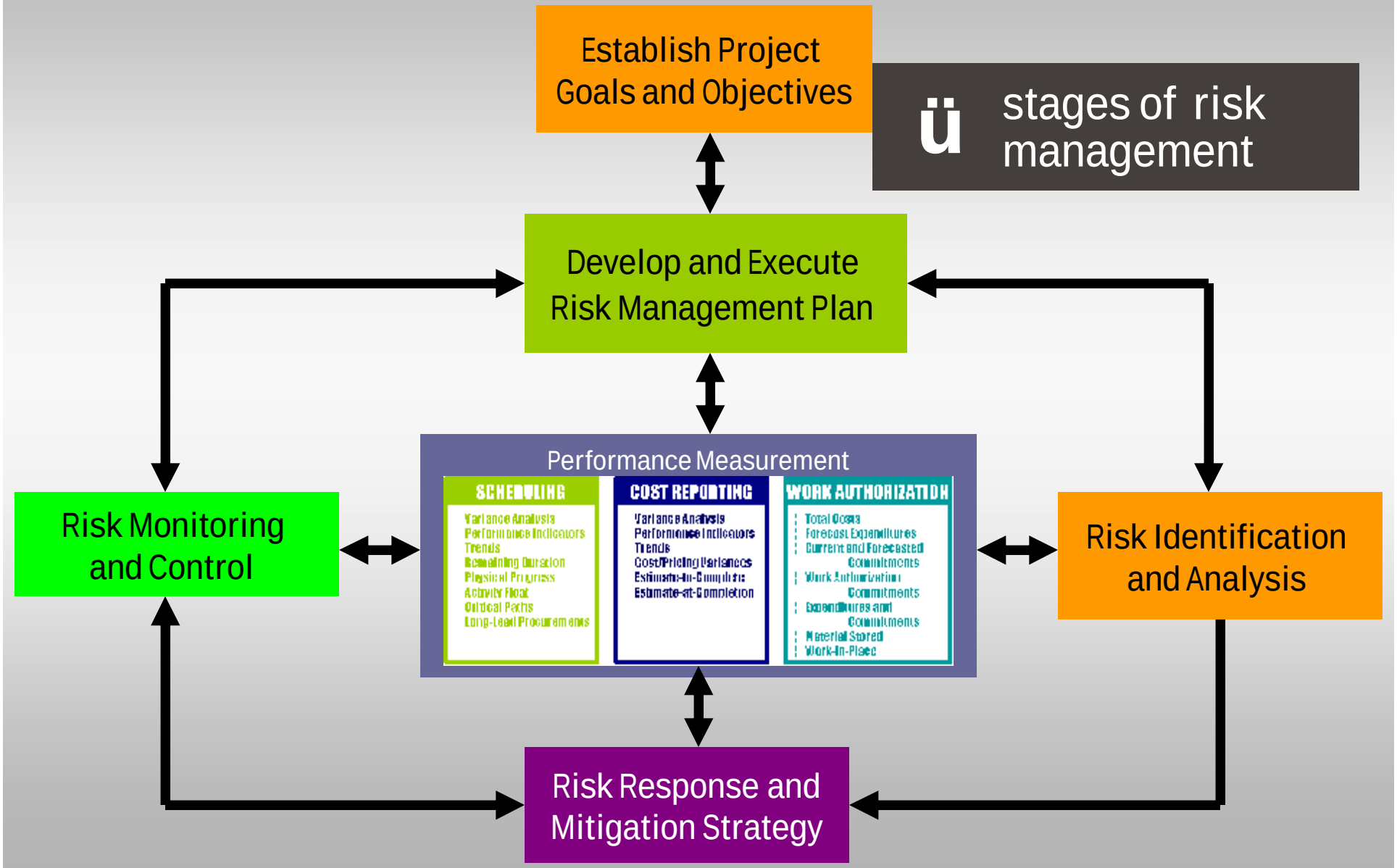
Percent (%) of construction cost overrun above the original baseline budget.

Introduction

- Need for new methods and practices
  - reducing costs
  - improving performance
- Allowing potential risks to go unmanaged or unaddressed
- Identifying, understanding, evaluating and mitigating risks

- ü implement risk management
- ü integrate risk management

Introduction



Introduction

Risk management principles

- Risk planning and management
- Be realistic when making assumptions
- Gather project information and expert judgments
- Understand risk elements and their impacts
- Assess and analyze risks impacts
- Develop mitigation and contingency plans
- Synthesize all risks to determine total impact
- Integrate risk management process
- Seek clear, realistic, and reliable project metrics
- Implement a continuous risk management process

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- ü 50 projects studied
- ü $150 billion is total expected cost

Risk Planning

- Recognize the need for applying risk management processes upfront; during the planning and pre-construction phase of the project development

Risk Planning

- Initiate the risk management process at the very beginning of the project
- Keep a strategic perspectives

1. Focus on the high-risk issues and their impacts
2. Consistently assess the adequacy of the mitigations and contingencies

Risk Planning

Overall strategy of the risk management program

Strategic Risk Process

Successful Project

< Maximize Opportunities

< Minimize Risk Impacts

Added Benefits

< Cost Effectiveness

< Schedule Control

< Contingency Management

Employing risk management processes to help attain success and meet expectations.

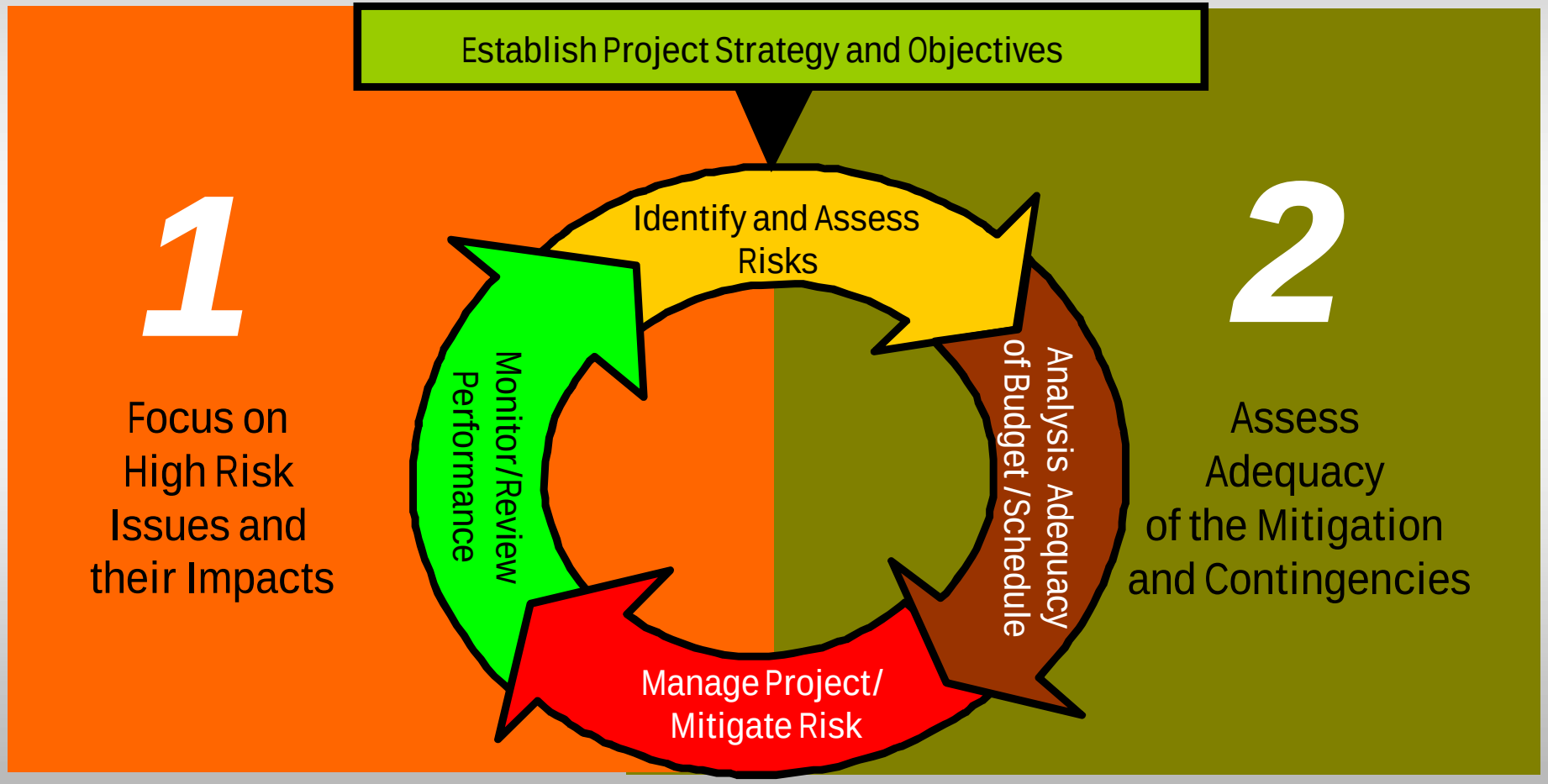
Risk Planning

- *Capital Construction Risk Management Plan*
  - summarize key definitions and risk terminology (common language)
  - construct the framework for how the risk management process will work
  - establish program and process policies (organizational structure)
  - document risk identification and mitigation methods through risk allocation
  - clearly identify each stage of the process (uniform and continuous process)

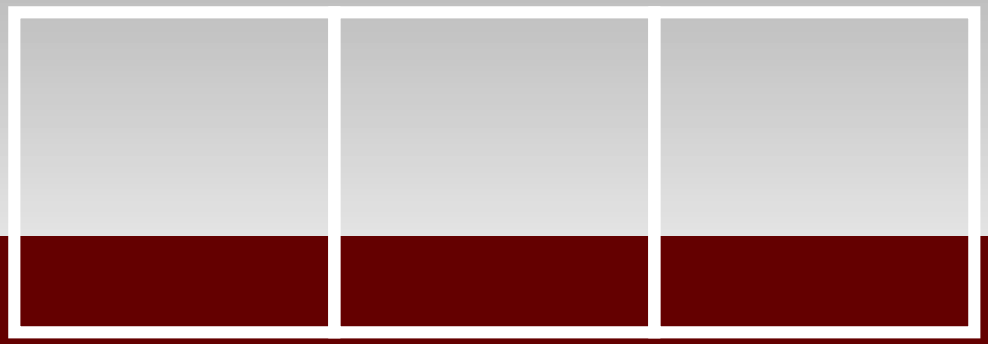
ü builds confidence

Risk Planning

A continuous process for risk strategy and management



An iterative and continuous process for managing risk as it changes and shifts.



Be Realistic When Making Project Assessments and Assumptions

- Don’t allow the project assumptions to be interpreted in too idealistic manner; influencing false thinking that everything is going well

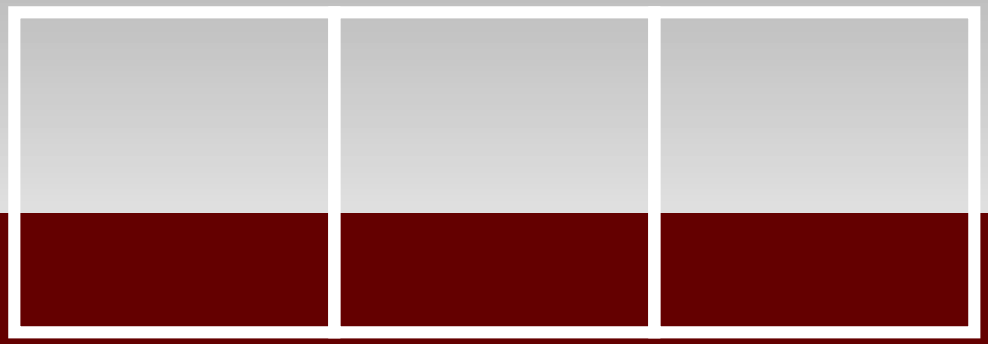
Be Realistic in Project Assumptions

- Everything going according to plan (EGAP)
- EGAP characteristically means
  - no major problems to draw management attention
  - no major project technical issues; i.e., geological, environmental, contracts, etc.
  - all political, economic, and administrative commitments and promises are kept
  - ü no apparent change in achieving the expected results

ü EGAP – a fatal flaw

Be Realistic in Project Assumptions

- Major causes of known risks
  - design and specification changes
  - geological, natural elements, problems, etc.
  - resource shortages i.e., manpower, material, etc.
  - existing conditions
- Major causes of unidentified risks
  - lack of realism in cost forecast
  - underestimating the impact of risks
  - underestimating the corrections and actions



Gather Risk Information and Expert Judgments

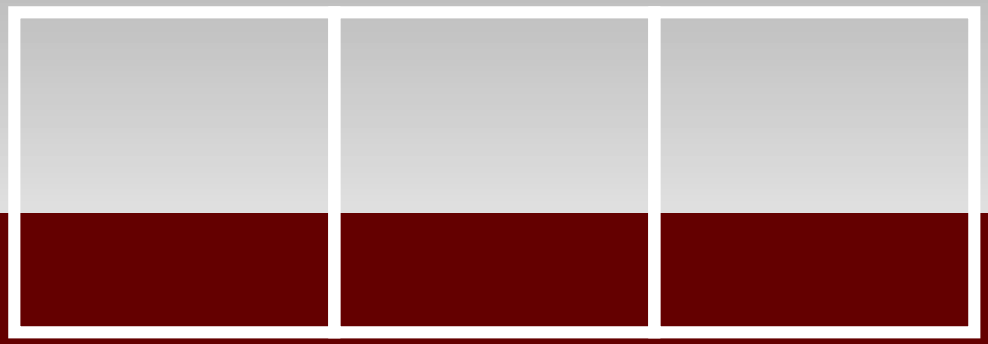
- Gather as much information about the project as feasible. Use experts to help define questionable issues. Remove biased views from assessments and analysis

Gather Risk Information and Expert Judgment

- Work sessions to discuss methods of a risk analysis process
  - discuss methods of a risk analysis process and gain consensus
- Gather risk information
  - interviews
  - risk review meetings
  - workshops
- - CII Advanced Planning Risk Analysis

ü collecting group judgment

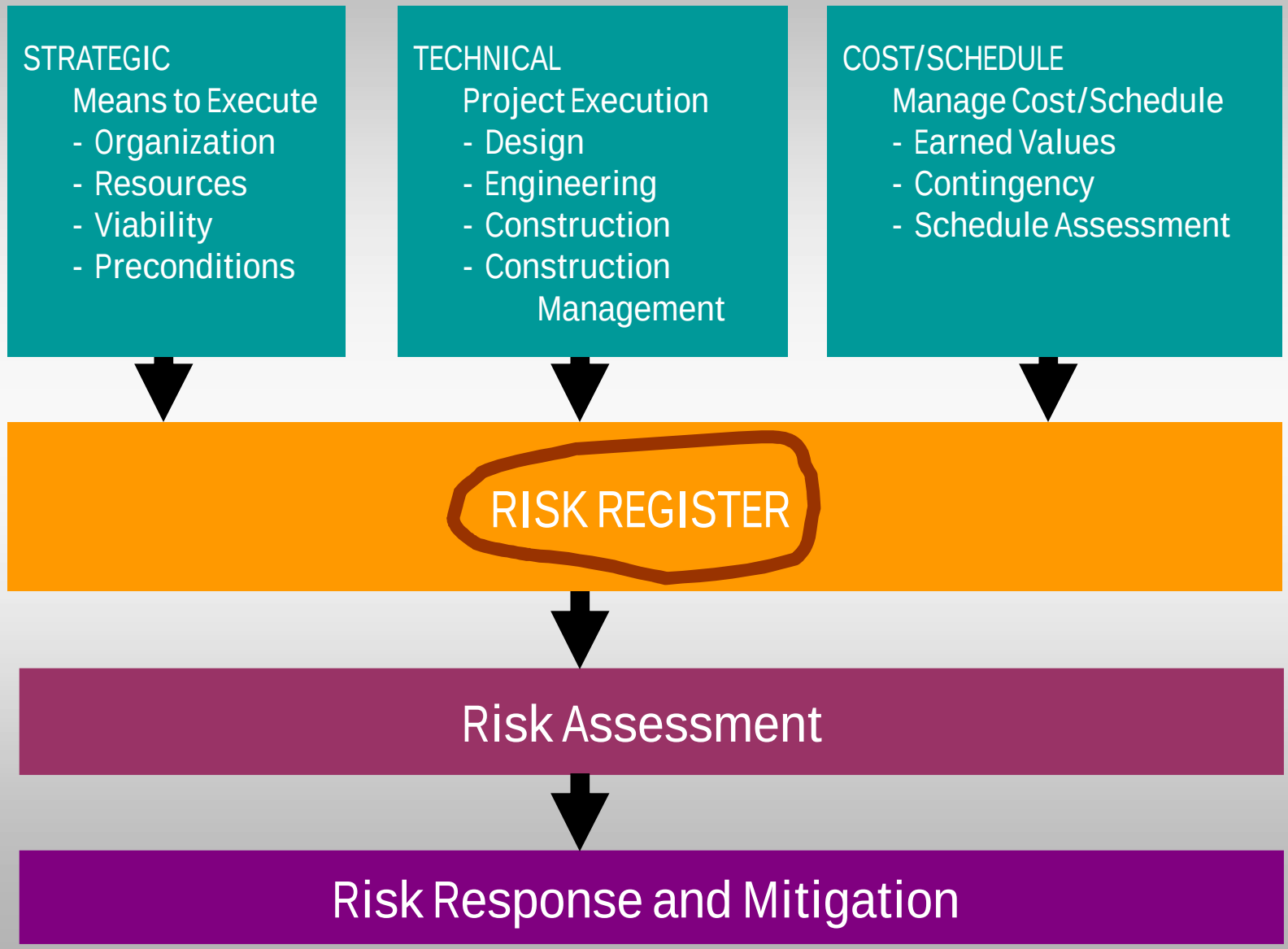
ü BOGSAT



Understand Risks Elements and Their Impacts

- Identify and clarify specific risks and their potential impacts early in the project planning and development

Understanding Risks Impacts



Understanding Risks Impacts

Risk register with risk evaluation criteria and remarks

Project Risk Management Register

Risk Register

Customer:	TRANSPORTATION and TRANSIT AGENCY		Project Start/Complete Date:	/						Proposal / Project Manager:		R.L. "Rick" Rye
Project Name:	MEGA PROJECT USA		Review Date:	13-Sep-05						Risk Representative:		
Sales Prospect Number:	2005 - P/CM		Revision Date:	13-Sep-05						Approved by:		
Location:	Metropolis, USA		Revision Number:	1								

Risk	Risk and Effects	Reference	Identified Risk	Mitigated Exposure	Execution Costs	Severity	Likelihood of Occurrence	Priority	Unmitigated Exposure	Need Event Cont.	Action Plan Responsible Party	Remarks
1	Changes in design particularly for the Architectural Center - interruption to project schedule and creating cost overruns	/	Client Indecision/ Interference Risk	0	0	Major	Almost Certain	5 - Very High		No		Establish configuration control process
2	Constructability constraints due to the unique design configurations - Interruption to project schedule and planning of sequence and phasing	/	Construction/ Constructability Risk	0	0	Major	Likely	4 - High		No		Value engineering, constructability reviews leading to planned consistency and controlling by configuration management
3	Changes in the scope of the Architectural Center because of the integration with adjacent project developments - will impact the planned construction phasing and sequence of execution		Client Indecision/ Interference Risk	0	0	Major	Likely	4 - High		No		

Understanding Risks Impacts

Risk register with risk evaluation criteria and remarks

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Sales Prospect Number:	2005 - P/CM		Revision Date:
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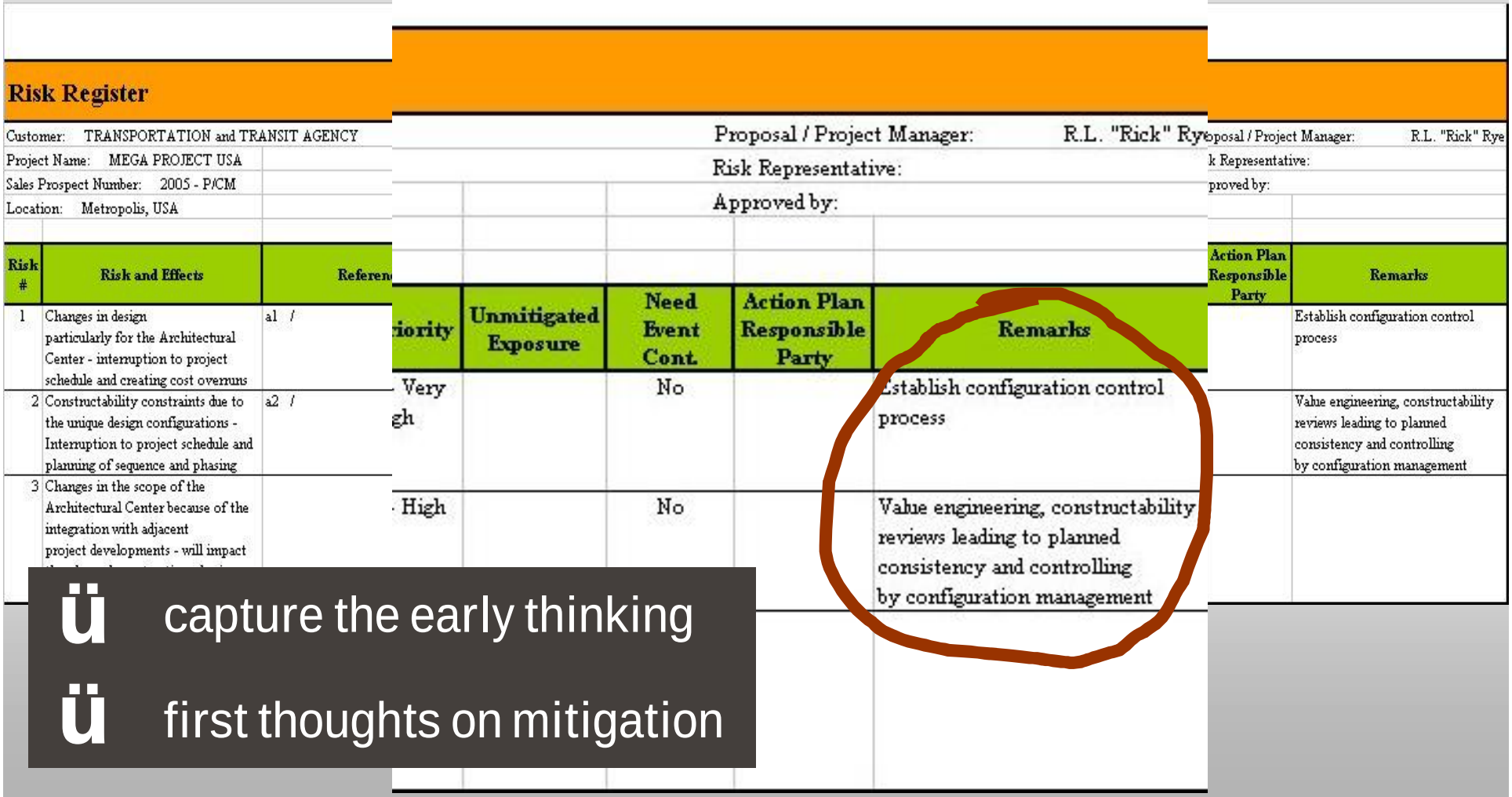
Risk #	Risk and Effects	Reference	Identified Risk
1	Changes in design particularly for the Architectural Center - interruption to project schedule and creating cost overruns	a1 /	Client Indecision/ Interference Risk
2	Constructability constraints due to the unique design configurations - Interruption to project schedule and planning of sequence and phasing	a2 /	Construction/ Constructability Risk
3	Changes in the scope of the Architectural Center because of the integration with adjacent project developments - will impact the planned construction phasing and sequence of execution		

- ü be specific
- ü be definitive

Understanding Risks Impacts

Risk register with risk evaluation criteria and remarks



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Project Name: MEGA PROJECT USA
Sales Prospect Number: 2005 - P/CM
Location: Metropolis, USA

Proposal / Project Manager: R.L. "Rick" Rye
Risk Representative:
Approved by:

Risk #	Risk and Effects	Reference	Priority	Unmitigated Exposure	Need Event Cont.	Action Plan Responsible Party	Remarks
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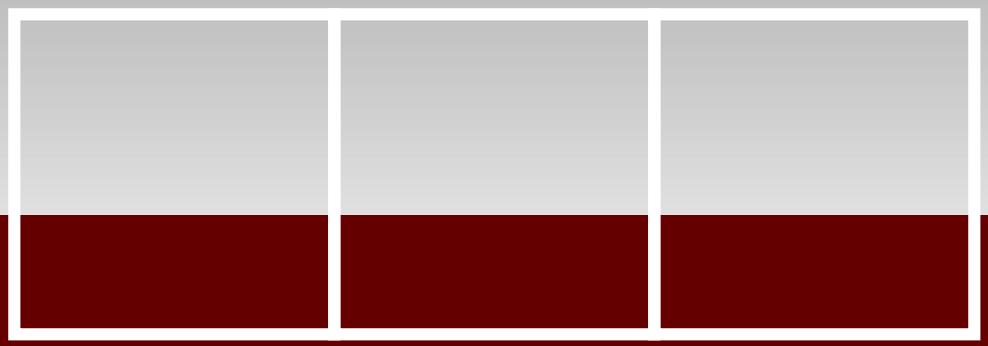
2	Constructability constraints due to the unique design configurations - Interruption to project schedule and planning of sequence and phasing	a2 /					Value engineering, constructability reviews leading to planned consistency and controlling by configuration management
3	Changes in the scope of the Architectural Center because of the integration with adjacent project developments - will impact		High		No		

- ü capture the early thinking
- ü first thoughts on mitigation



Assess and Analyze Risks Impacts

- Evaluate and analyze all risks elements to the point of determining the degree of their impacts on the project goals and objectives

Assess and Analyze Risks Impacts

- Logical way of assessing and measuring potential impacts
  - evaluation of risk events or opportunities
- Two major approaches to logical risk analysis
  - deterministic approach
  - probabilistic analysis

ü supported by existing systems

ü statistical analysis and modeling

Assess and Analyze Risks Impacts

SCHEDULING

- Variance Analysis
- Performance Indicators
- Trends
- Remaining Duration
- Physical Progress
- Activity Float
- Critical Paths
- Long-Lead Procurements

COST REPORTING

- Variance Analysis
- Performance Indicators
- Trends
- Cost/Pricing Variances
- Estimate-to-Complete
- Estimate-at-Completion

WORK AUTHORIZATION

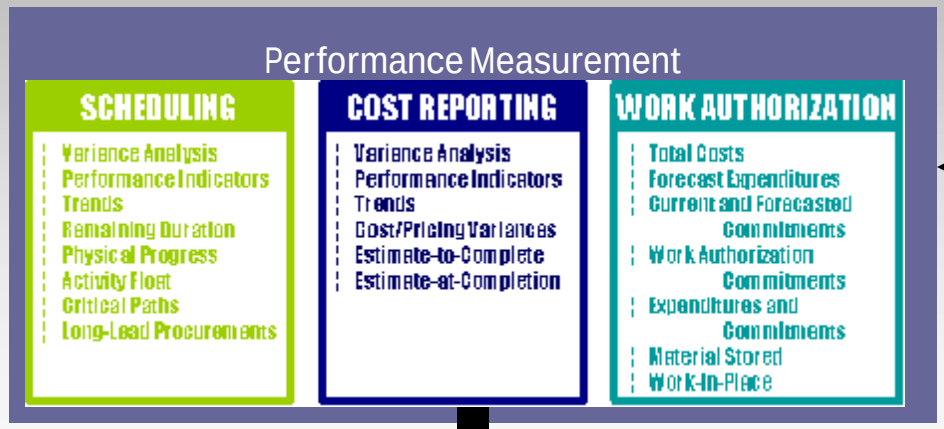
- Total Costs
- Forecast Expenditures
- Current and Forecasted Commitments
- Work Authorization Commitments
- Expenditures and Commitments
- Material Stored
- Work-in-Place

Collecting Information and Data

ü earned value measurement

Analysis and Interpreting the Expected Performance

Assess and Analyze Risks Impacts



Collecting Information and Data

Analyzing and Interpreting the Expect

Risk Register

Risk Analysis Process

ü statistical analysis and modeling

Assess and Analyze Risks Impacts

- Use risk evaluation scoring to assign values to risks
  - numerical interpretation for analysis
- Risk event status
  - probability of occurrence (likelihood of the event happening
  - severity of impact (cost or time at stake)

risk event status =
risk probability X amount at stake =

Assess and Analyze Risks Impacts

Risk evaluation scoring criteria for the probability of occurrence to the likelihood of occurrence

Probability of Occurrence	Likelihood	
0% - 10%	1	Rare
11% - 25%	2	Unlikely
26% - 75%	3	Possible
76% - 90%	4	Likely
91% - 100%	5	Almost Certain

Correlation between qualitative description and the quantitative metric

Assess and Analyze Risks Impacts

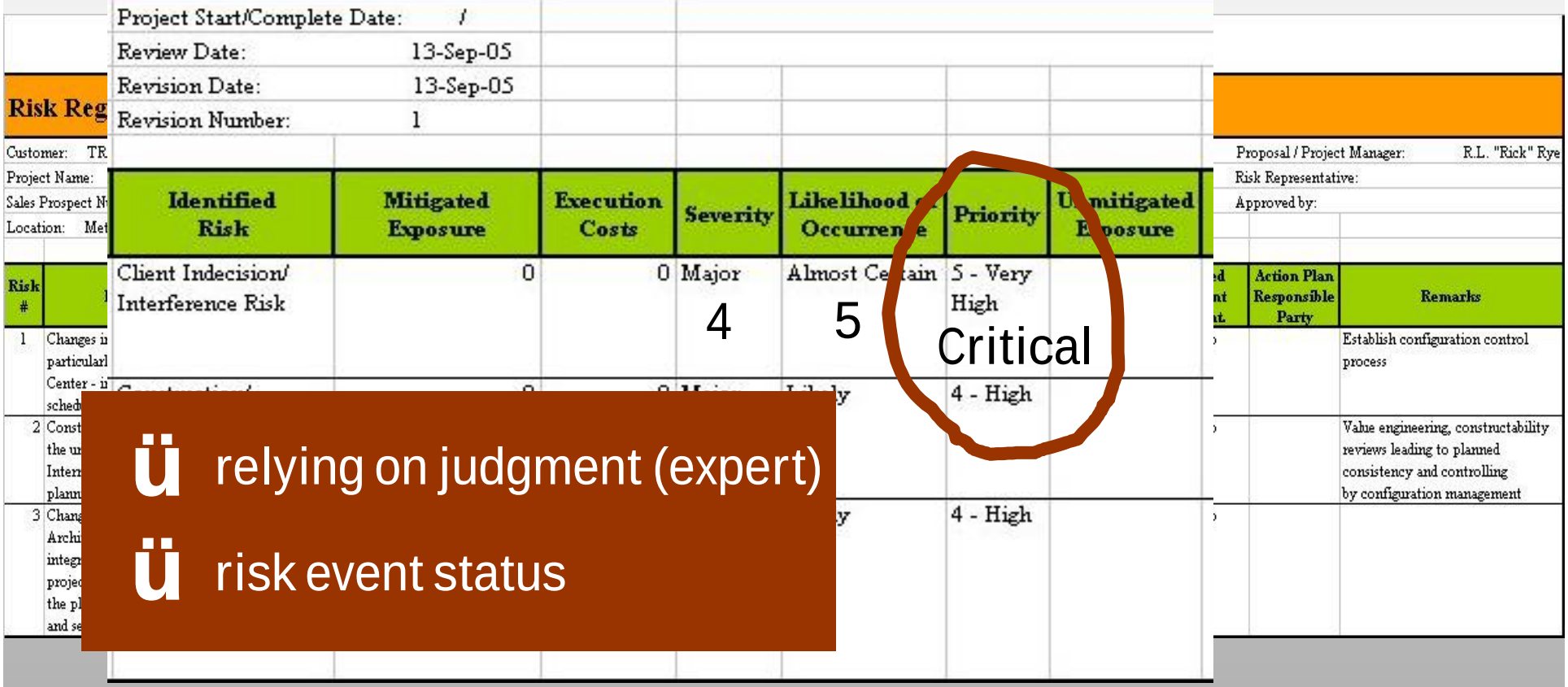
Risk evaluation scoring criteria for financial exposure to severity of impact

Financial Exposure	Severity	
Up to $10,000	**1**	**Minor**
Up to $250,000	**2**	**Moderate**
Up to $500,000	**3**	**Serious**
Up to $1 million	**4**	**Major**
Over $1 million	**5**	**Critical**

Associating severity measurements to potential financial impacts or variations

Assess and Analyze Risks Impacts

Risk register with risk evaluation scoring and remarks



Project Risk Management Register

Project Start/Complete Date:	/
Review Date:	13-Sep-05
Revision Date:	13-Sep-05
Revision Number:	1

Identified Risk	Mitigated Exposure	Execution Costs	Severity	Likelihood of Occurrence	Priority	Unmitigated Exposure
Client Indecision/ Interference Risk	0	0	Major 4	Almost Certain 5	5 - Very High Critical	
					4 - High	
					4 - High	

Risk Reg

Customer: TR

Project Name:

Sales Prospect N

Location: Met

Proposal / Project Manager: R.L. "Rick" Rye

Risk Representative:

Approved by:

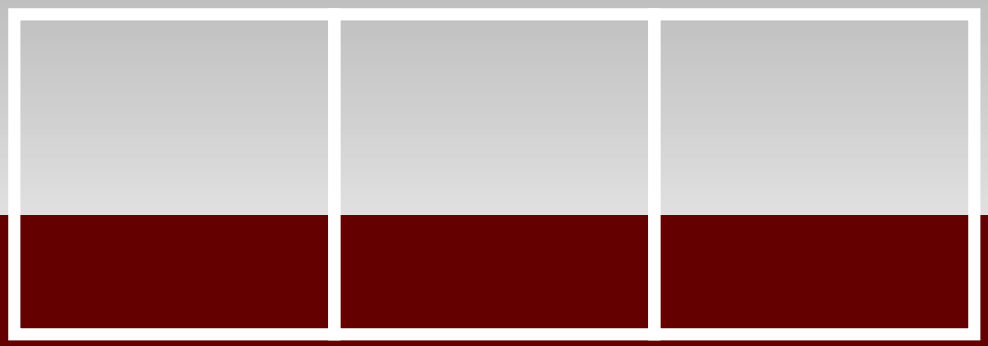
Risk #		Action Plan Responsible Party	Remarks
1	Changes in particularl Center - in sched		Establish configuration control process
2	Const the un Intern plann		Value engineering, constructability reviews leading to planned consistency and controlling by configuration management
3	Chang Archi integr proje the pl and se		

- ü relying on judgment (expert)
- ü risk event status

Assess and Analyze Risks Impacts

Top 10 impact risks priorities – the "Watch" list;

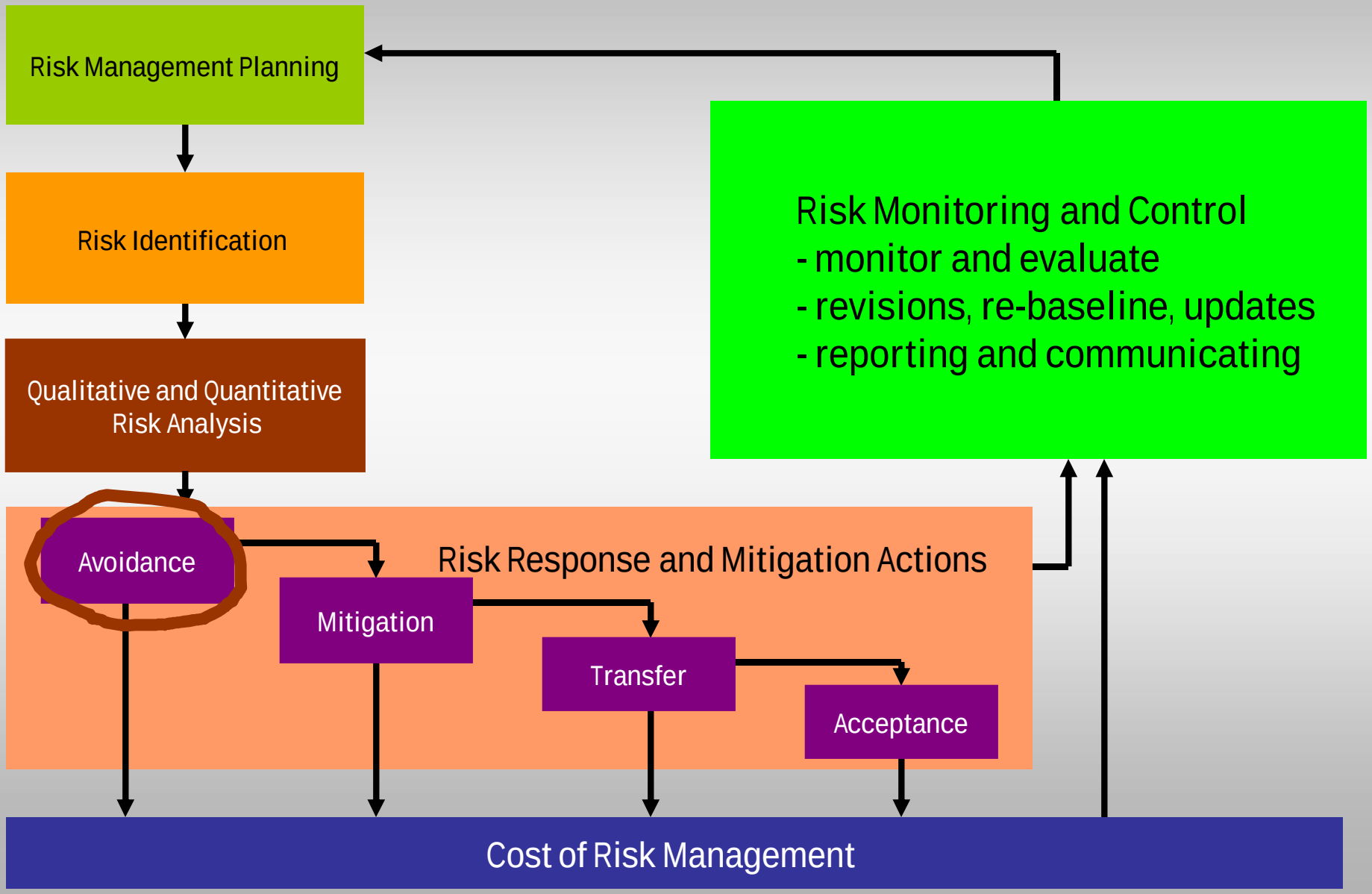
1. Compressed design schedule	Critical
2. Lack of timely decisions and information flow	Critical
3. Changes in design criteria and scope	Major
4. Environmental planning and impacts (NEPA)	Major
5. Very tight security requirements	Major
6. Lack of available resources	Serious
7. Logistics problems	Serious
8. Unique technology and innovative design	Serious
9. Release for property access	Moderate
10. Construction critical path impacts	Moderate



Mitigation and Contingency Planning

- Develop mitigation and contingency plans that are sufficient for the priority or the degree of impact associated with the risk

Develop Mitigation and Contingency Plans



Develop Mitigation and Contingency Plans

- Risks responses and mitigations strategies include options such as
  - control measures
  - management actions
  - contractual arrangements
  - third party i.e. contractors, insurance, etc.
  - resource provisions
  - contingency and reserve funds

ü determine effectiveness in actions

ü mitigations actions cost

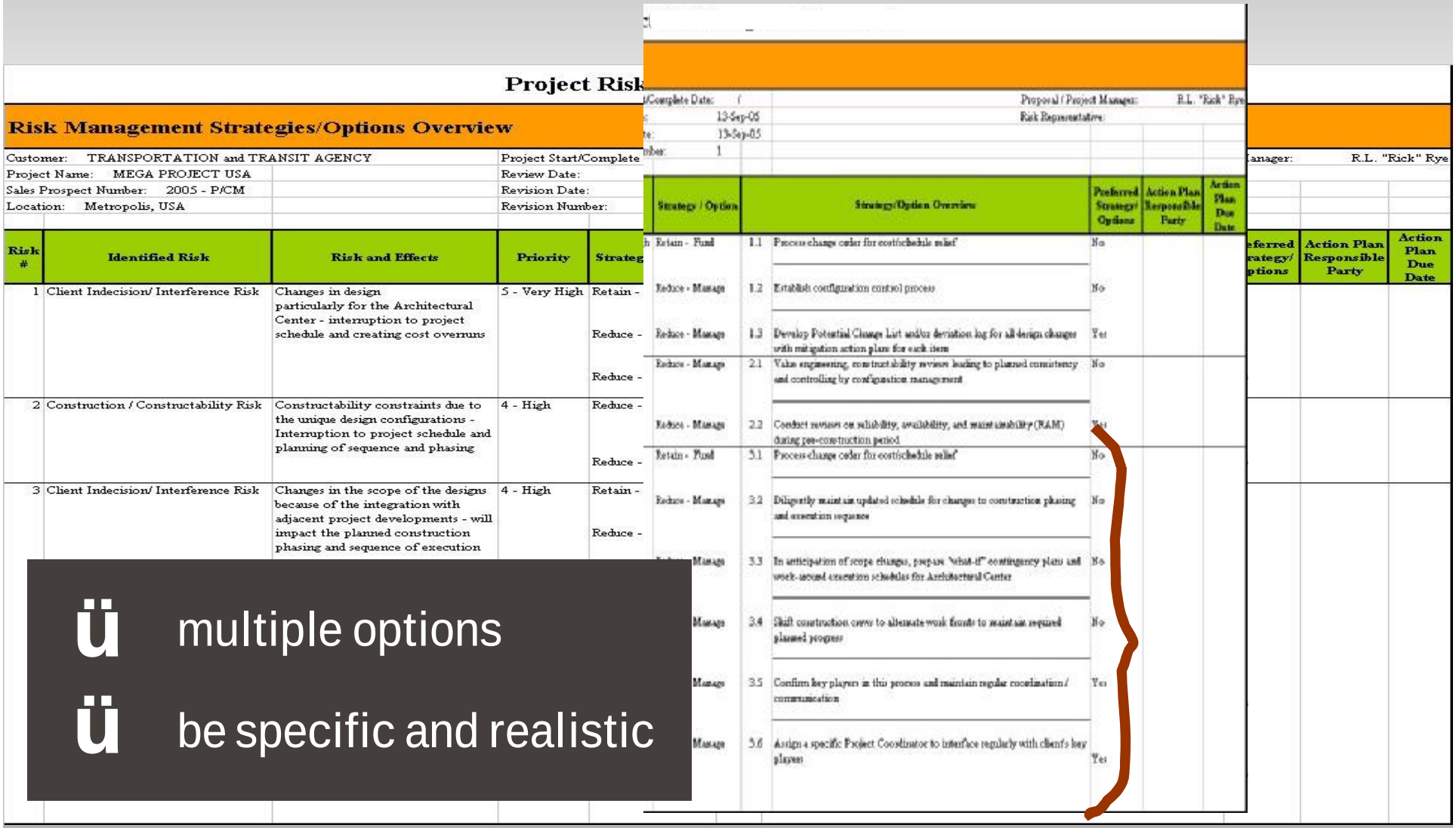
Develop Mitigation and Contingency Plans

- Contingency is typically an integral part of budget estimating
  - an arbitrary value
  - when added to the base estimate, or schedule, for unknowns
  - when used to offset unclear or unknown issues

ü contingencies overestimated of underestimated

Develop Mitigation and Contingency Plans

Risk response strategies and options profile and ledger



Project Risk

Risk Management Strategies/Options Overview

Customer: TRANSPORTATION and TRANSIT AGENCY
Project Name: MEGA PROJECT USA
Sales Prospect Number: 2005 - P/CM
Location: Metropolis, USA
Project Start/Complete
Review Date:
Revision Date:
Revision Number:
Manager: R.L. "Rick" Rye

Risk #	Identified Risk	Risk and Effects	Priority	Strateg
1	Client Indecision/ Interference Risk	Changes in design particularly for the Architectural Center - interruption to project schedule and creating cost overruns	5 - Very High	Retain - Reduce - Reduce -
2	Construction / Constructability Risk	Constructability constraints due to the unique design configurations - Interruption to project schedule and planning of sequence and phasing	4 - High	Reduce - Reduce -
3	Client Indecision/ Interference Risk	Changes in the scope of the designs because of the integration with adjacent project developments - will impact the planned construction phasing and sequence of execution	4 - High	Retain - Reduce -

Complete Date: 13-Sep-05
Revision: 13-Sep-05
Number: 1
Proposal / Project Manager: R.L. "Rick" Rye
Risk Representative:

Strategy / Option		Strategy/Option Overview	Preferred Strategy/ Options	Action Plan Responsible Party	Action Plan Due Date
Retain - Fund	1.1	Process change order for cost/schedule relief	No		
Reduce - Manage	1.2	Establish configuration control process	No		
Reduce - Manage	1.3	Develop Potential Change List and/or deviation log for all design changes with mitigation action plans for each item	Yes		
Reduce - Manage	2.1	Value engineering, constructability reviews leading to planned consistency and controlling by configuration management	No		
Reduce - Manage	2.2	Conduct reviews on reliability, availability, and maintainability (RAM) during pre-construction period	Yes		
Retain - Fund	5.1	Process change order for cost/schedule relief	No		
Reduce - Manage	3.2	Diligently maintain updated schedule for changes to construction phasing and execution sequence	No		
Manage	3.3	In anticipation of scope changes, prepare "what-if" contingency plans and work-around execution schedules for Architectural Center	No		
Manage	3.4	Shift construction crews to alternate work fronts to maintain required planned progress	No		
Manage	3.5	Confirm key players in this process and maintain regular coordination / communication	Yes		
Manage	5.6	Assign a specific Project Coordinator to interface regularly with client's key players	Yes		

- ü multiple options
- ü be specific and realistic

Develop Mitigation and Contingency Plans

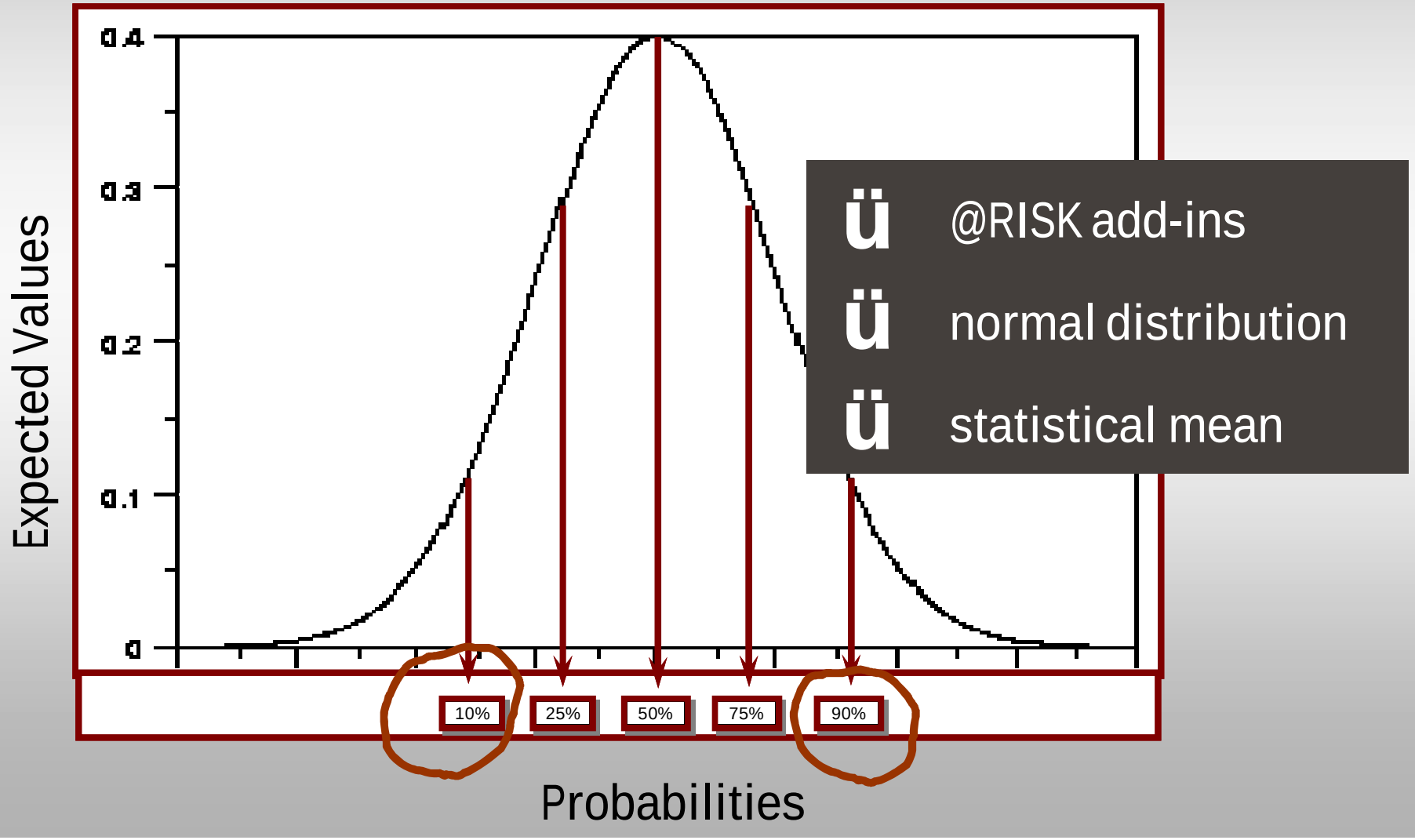
- Risk response actions have a resource value
  - cost (budget or contingency)
  - time (budget or float)
- Not cost effective to mitigate all risks
  - adequate contingencies and reserves
- Logical vehicle for predicting the extent of variations
  - forecasting the best case scenarios and worst case scenarios

ü worst case

ü most unpopular

Develop Mitigation and Contingency Plans

Probability distribution representing variations of probable occurrence

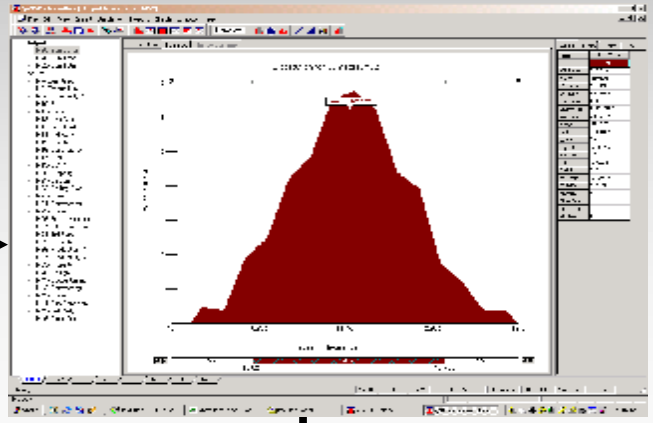


- ü @RISK add-ins
- ü normal distribution
- ü statistical mean

Develop Mitigation and Contingency Plans

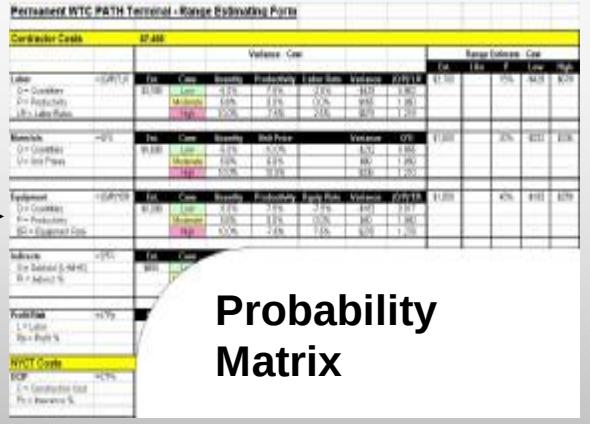
Risk Register (Cost/Schedule)

Statistical Analysis (@RISK)



Potential Changes to Present Estimate

Labor costs are expected to vary due to changes in quantities, productivity or rates



Probability Matrix

Develop Mitigation and Contingency Plans

Mitigation model and range estimating with probability

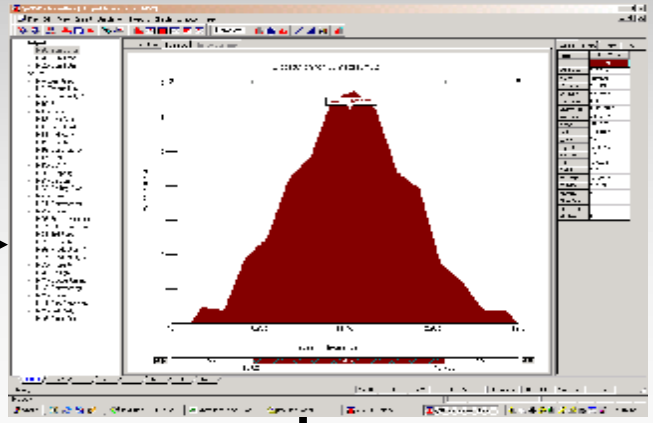
Contractor Costs		$7,485											
		Variance - Cost							Range Estimate - Cost				
									Est.	Like	P	Low	High
Labor	=(Q/P)*LR	Est.	Case	Quantity	Productivity	Labor Rate	Variance	(Q/P)*LR	$3,100		15%	-$429	$679
Q = Quantities		$3,100	Low	-5.0%	7.5%	-2.5%	-$429	0.862					
P = Productivity			Moderate	5.0%	0.0%	0.0%	$155	1.050					
LR = Labor Rates			High	10.0%	-7.5%	2.5%	$679	1.219					
Materials	=Q*U	Est.	Case	Quantity	Unit Price		Variance	Q*U	$1,600		20%	-$232	$336
Q = Quantities		$1,600	Low	-5.0%	-10.0%		-$232	0.855					
U = Unit Prices			Moderate	5.0%	0.0%		$80	1.050					
			High	10.0%	10.0%		$336	1.210					
Equipment	=(Q/P)*ER	Est.	Case	Quantity	Productivity	Equip Rate	Variance	(Q/P)*ER	$1,000		40%	-$183	$278
Q = Quantities		$1,000	Low	-5.0%									
P = Productivity			Moderate	5.0%									

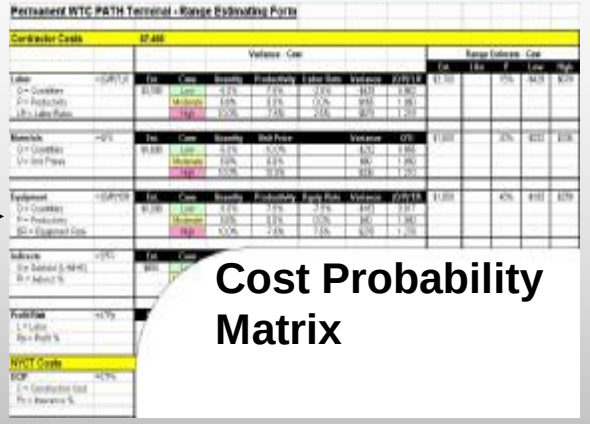
- ü budget elements
- ü event and scope elements

Develop Mitigation and Contingency Plans

Risk Register (Cost/Schedule)

Statistical Analysis (@RISK)





Cost Probability Matrix

Potential Changes to Present Estimate

Labor costs are expected to vary due to changes in quantities, productivity or rates

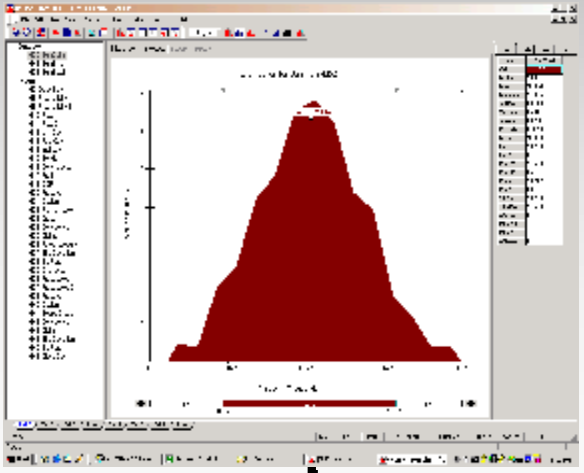
Develop Mitigation and Contingency Plans

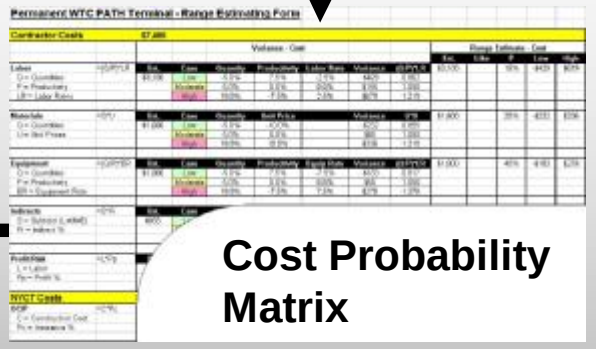
Risk Register (Cost/Schedule)

→

Statistical Analysis (@RISK) (Crystal Ball)

→





Cost Probability Matrix

←

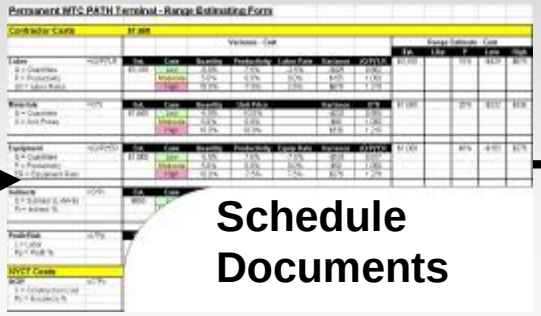
Cost Risks Report

Estimated Cost	P	Low	High
$3.10 M	15%	$2.67 M	$3.78 M

ü confidence level

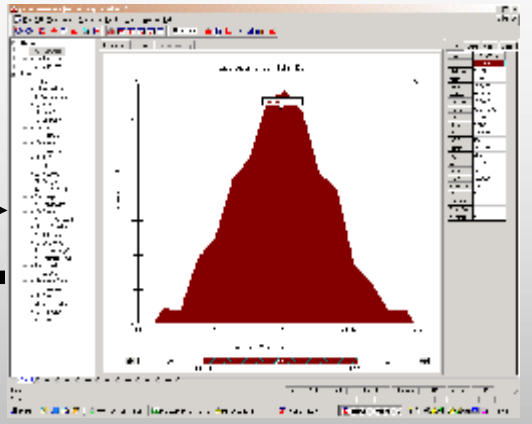
Develop Mitigation and Contingency Plans

Risk Register (Cost/Schedule)



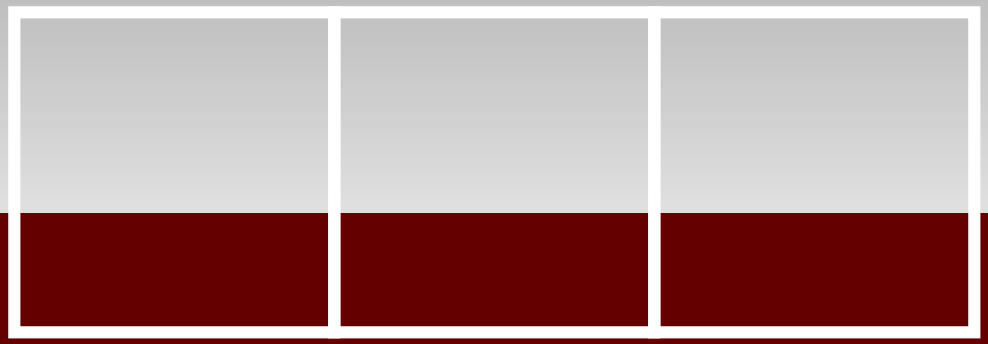
Schedule Documents

Simulations (PertMaster)



Schedule Risks Report

Estimated Days	P	Low	High
220	15%	210	240



Synthesizing the Risks

- Synthesizing all potential project risks and determine the total cumulative effect

Synthesizing the Risks

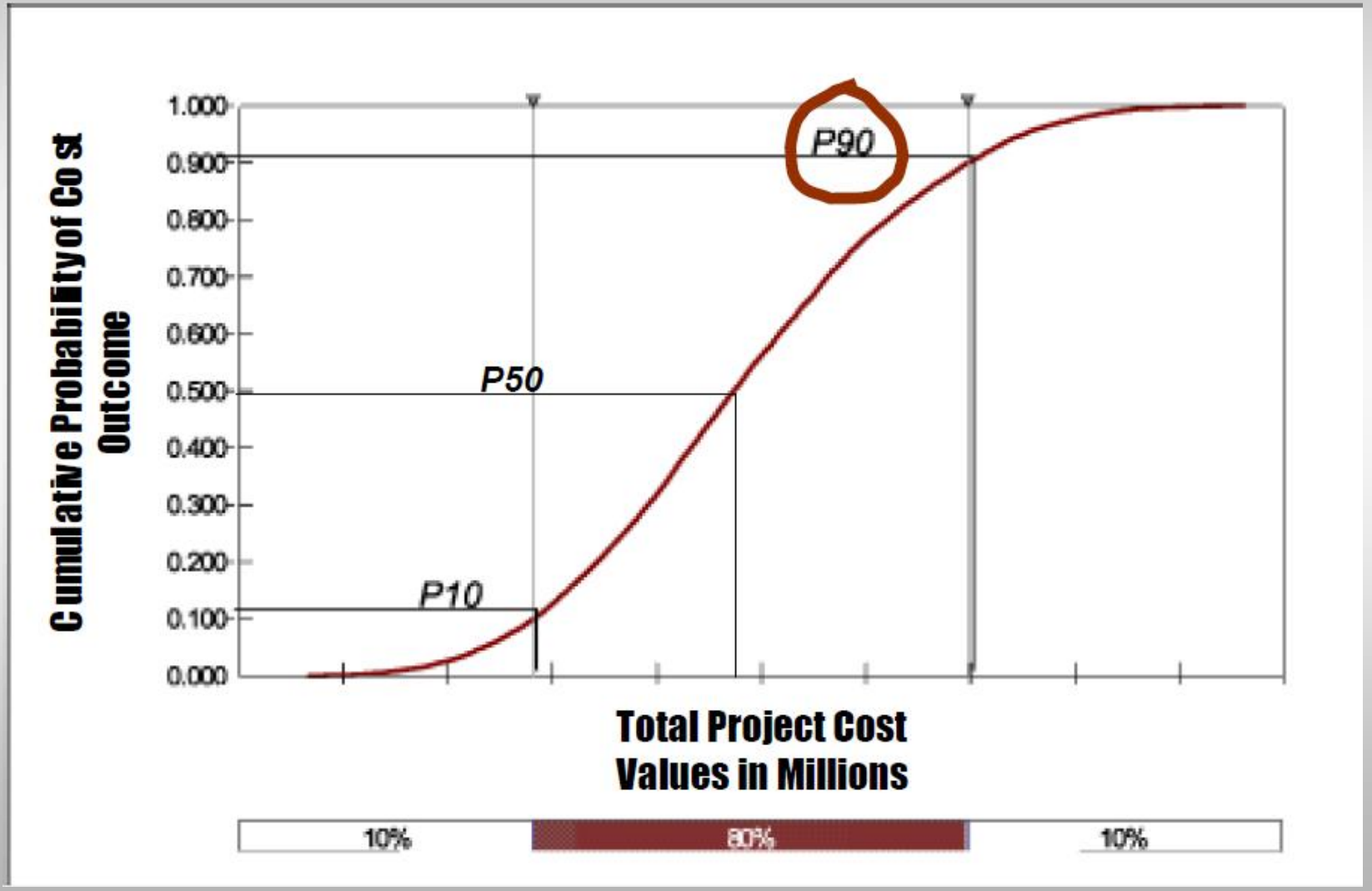
- Deterministic evaluation has limits
- Develop a logical model for overall project risks measurement to mitigate and manage
- Probabilistic methods for overall statistical model analysis and simulation
  - determine that the mitigation costs is adequate
  - giving expectations that the project will meet objectives
  - help provide confidence in the expected project cost

ü @RISK analysis

ü PertMaster

Synthesizing the Risks

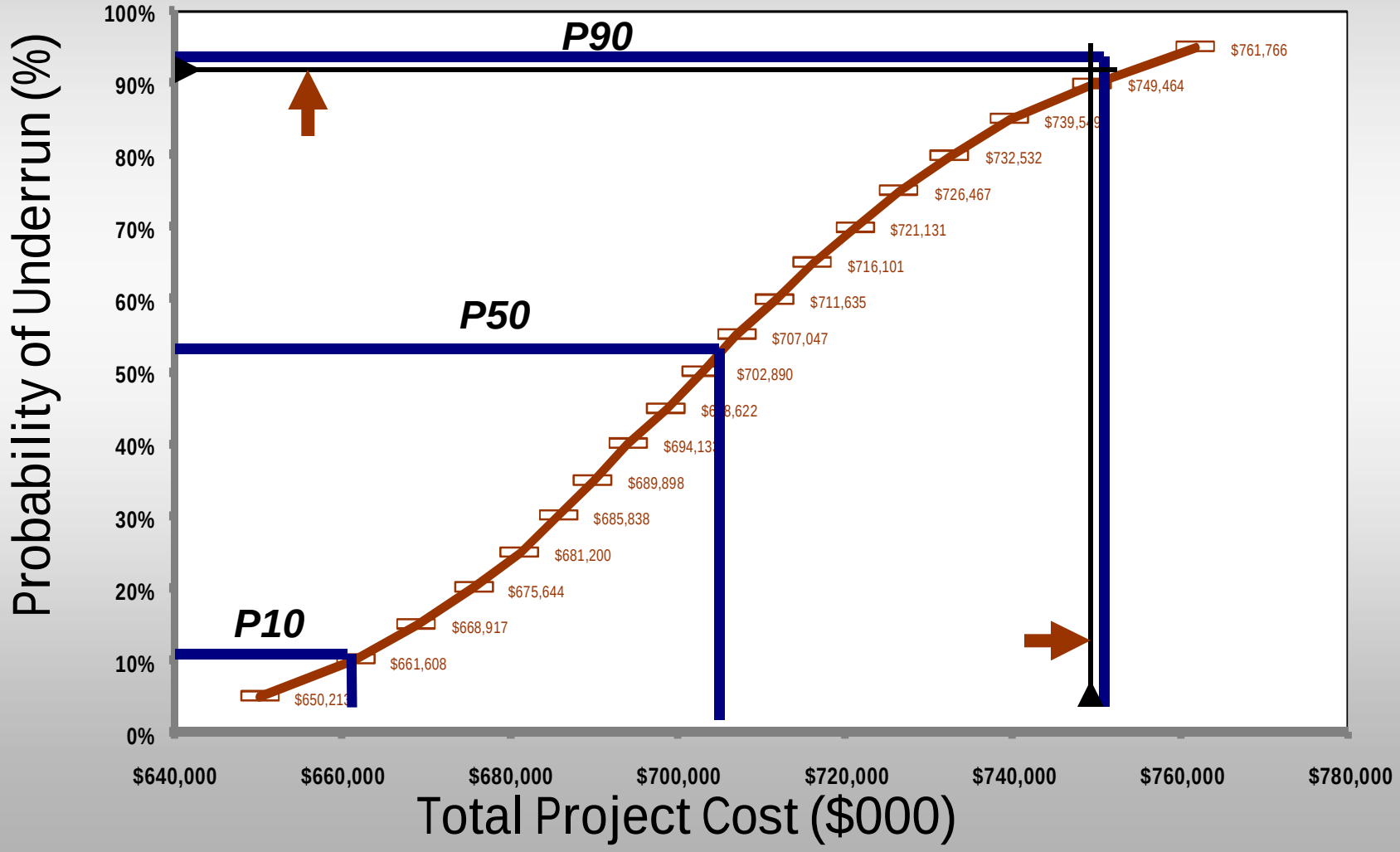
Cumulative probability distribution curves



Synthesizing the Risks

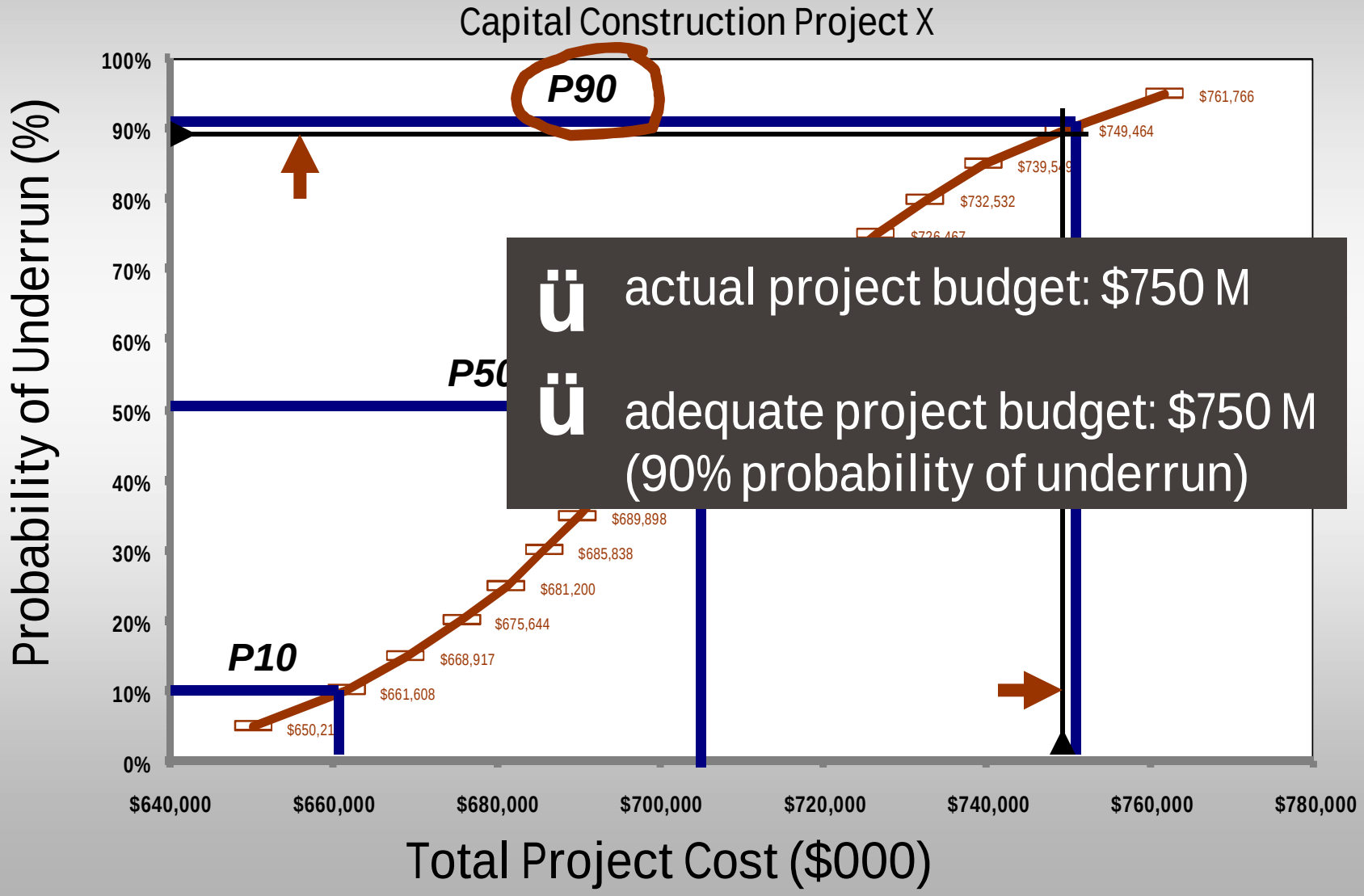
Project cost contingency analysis probability of occurrence

Capital Construction Project X



Synthesizing the Risks

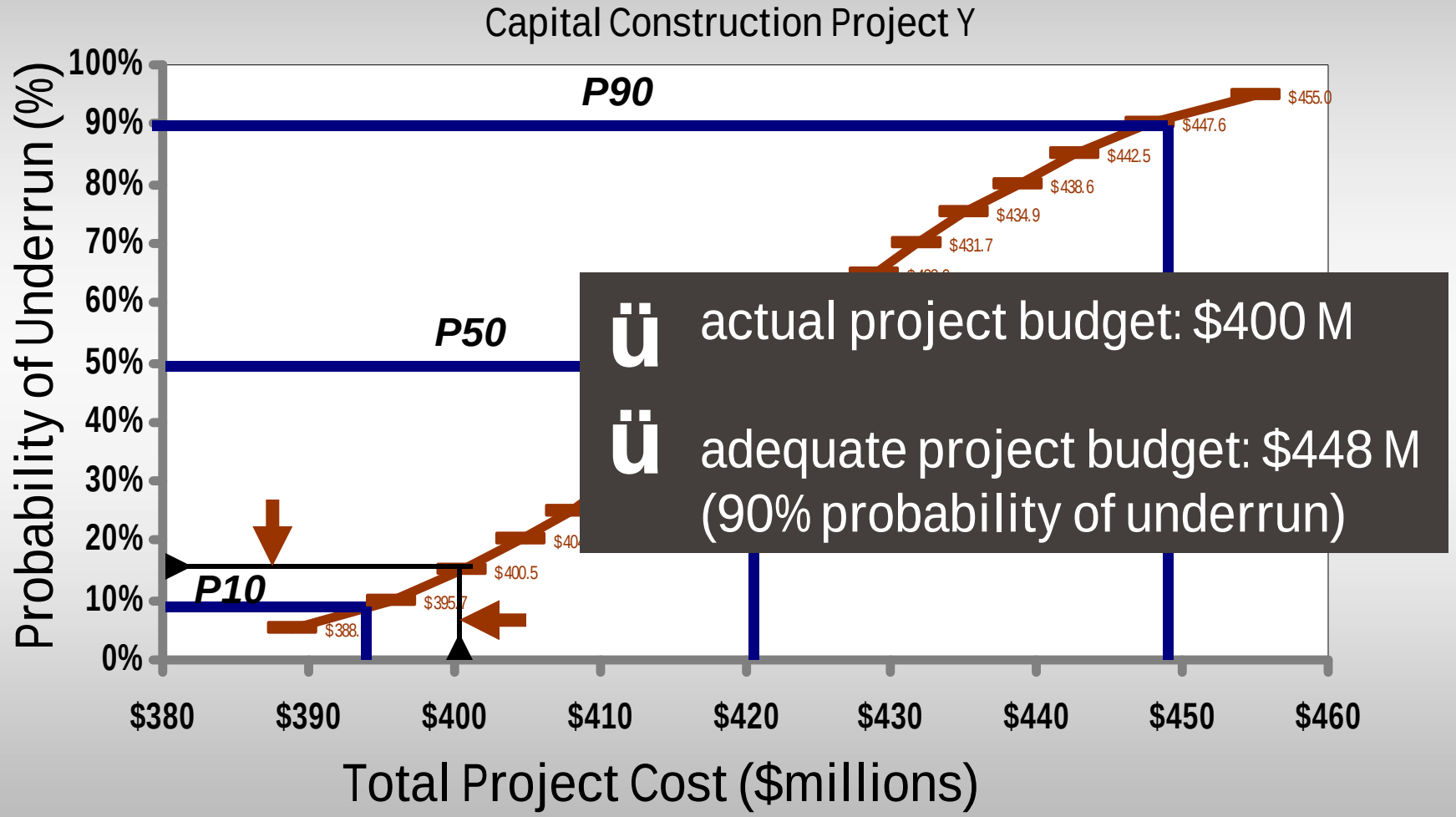
Project cost contingency analysis probability of occurrence



- ü actual project budget: $750 M
- ü adequate project budget: $750 M (90% probability of underrun)

Synthesizing the Risks

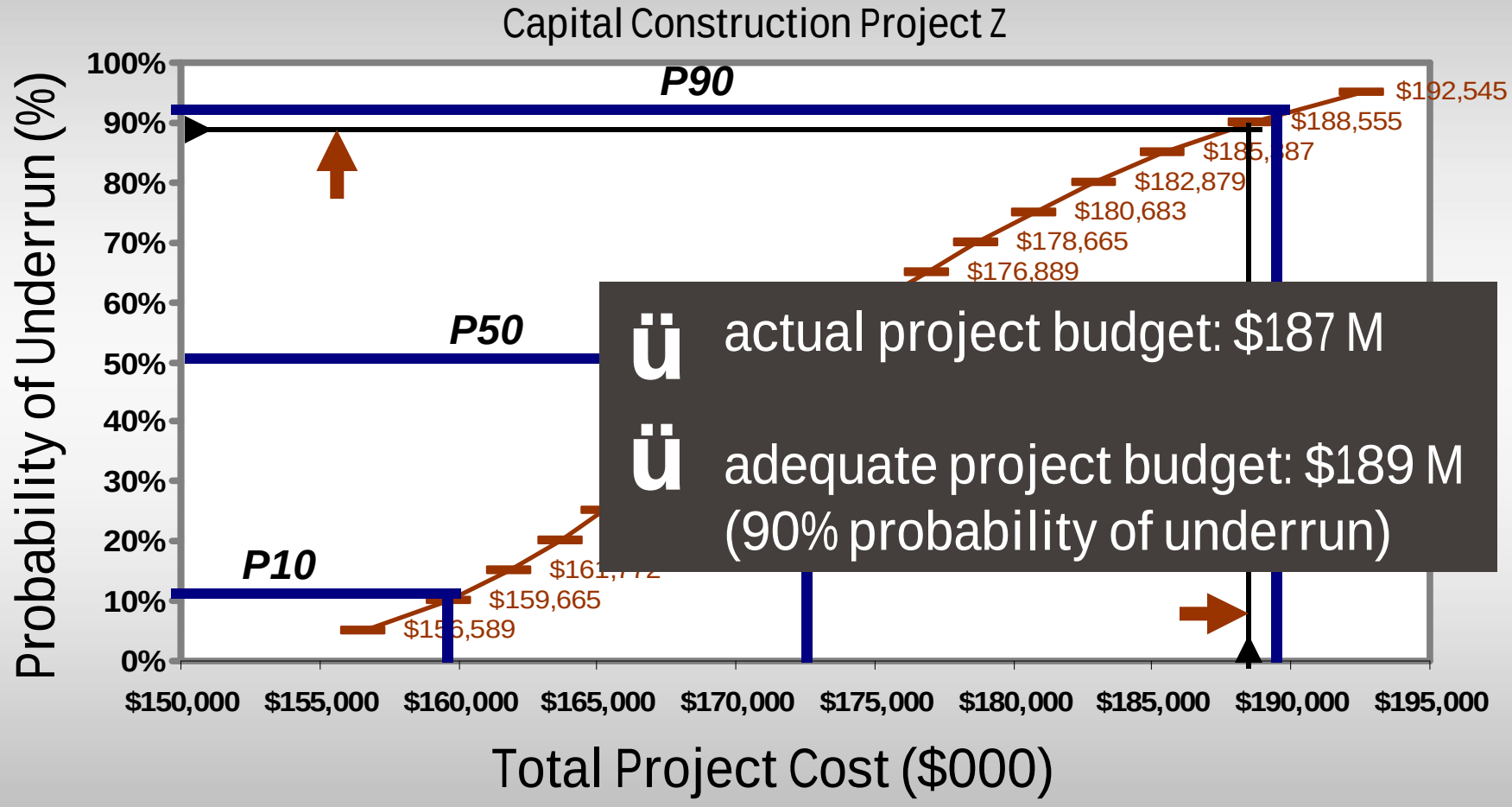
Project cost contingency analysis probability of occurrence



- ü actual project budget: $400 M
- ü adequate project budget: $448 M (90% probability of underrun)

Synthesizing the Risks

Project cost contingency analysis probability of occurrence

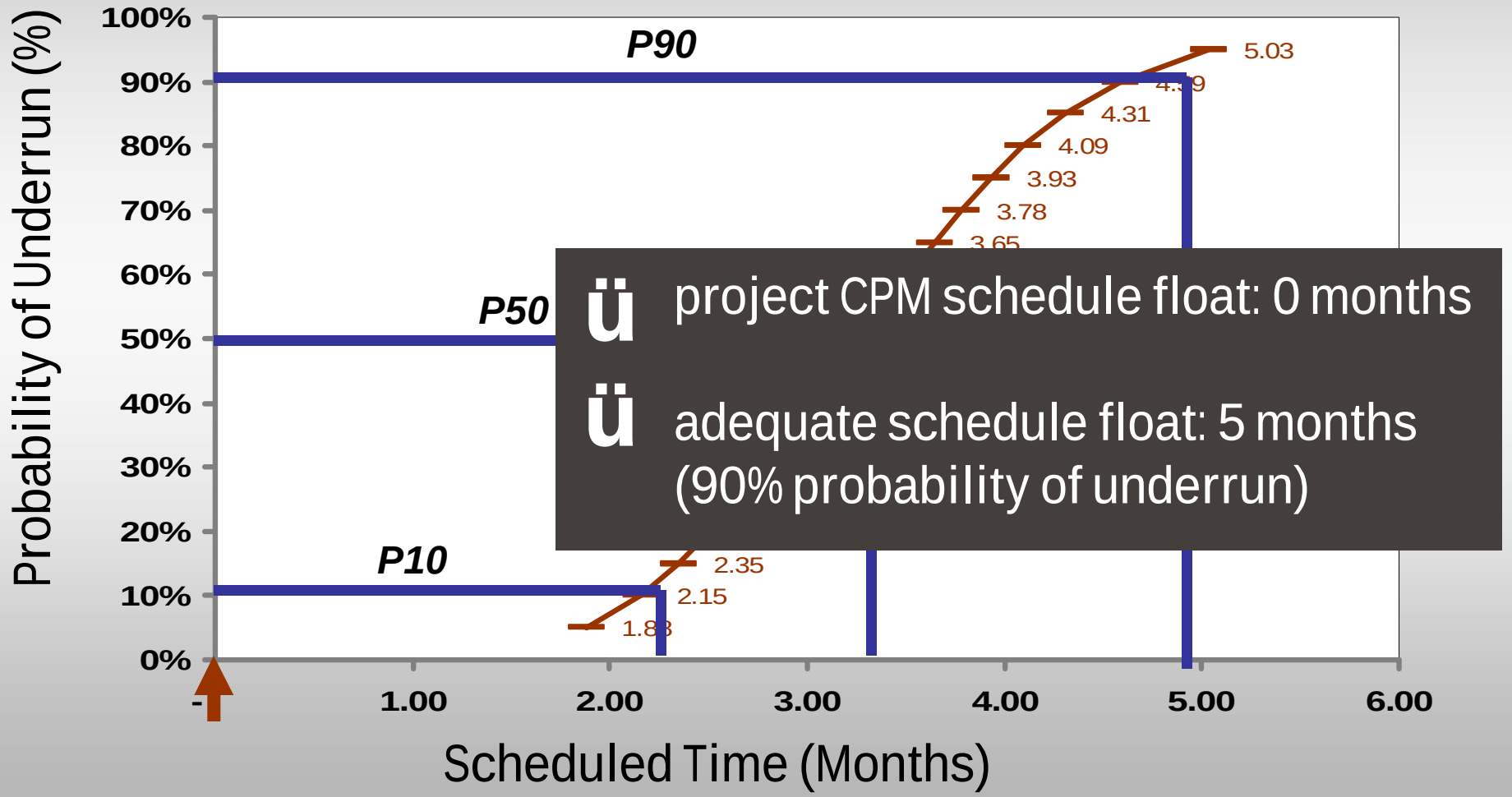


- ü actual project budget: $187 M
- ü adequate project budget: $189 M (90% probability of underrun)

Synthesizing the Risks

Project schedule contingency analysis probability of occurrence

Capital Construction Project Z



- ü project CPM schedule float: 0 months
- ü adequate schedule float: 5 months (90% probability of underrun)

Synthesizing the Risks

Project risk-based mitigation cost contingency

Mitigation Cost Profile with Probabilities				
	Project Cost w/o Risk Process	Mitigation Cost and Contingency		Expected Total Project Costs
Current Estimate	$1,668.36	$365.59	21.9%	$2,033.95
P10	$1,668.36	$178.64	10.7%	$1,847.00
Mean	$1,668.36	$373.07	22.4%	$2,041.43
P90	$1,668.36	$570.84	34.2%	$2,239.2

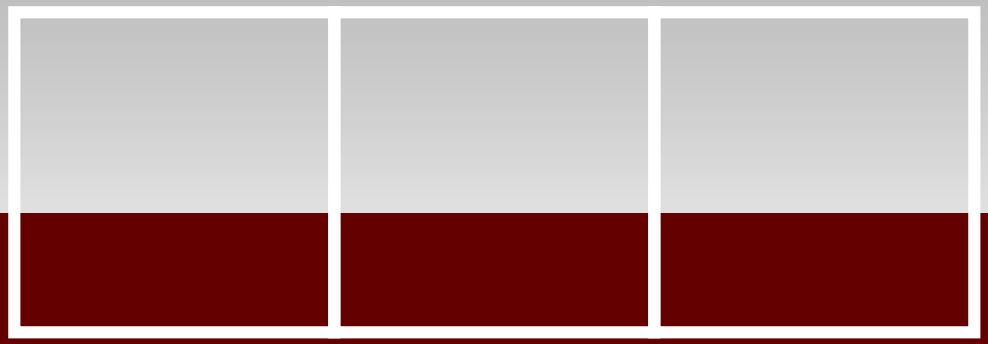
Dollar values represent millions ($000)

Synthesizing the Risks

- Benefits of probabilistic contingency models and simulations
  - provides explicit information for making informed decisions
  - assist in the overall predictability for meeting the owners expectations

ü measure adequacy of resource contingencies

ü to the best of our judgment



Integrate the Risks Management Process

- Integrate the risk management process with the day-to-day construction project management applications

Integrate the Risks Management Process

- Major objectives of integrated risk management approach
  - integrating mitigation planning before the consequence (feedback)
  - enhancing the identification of resources for project management
  - facilitating continuous monitoring, analysis and communication

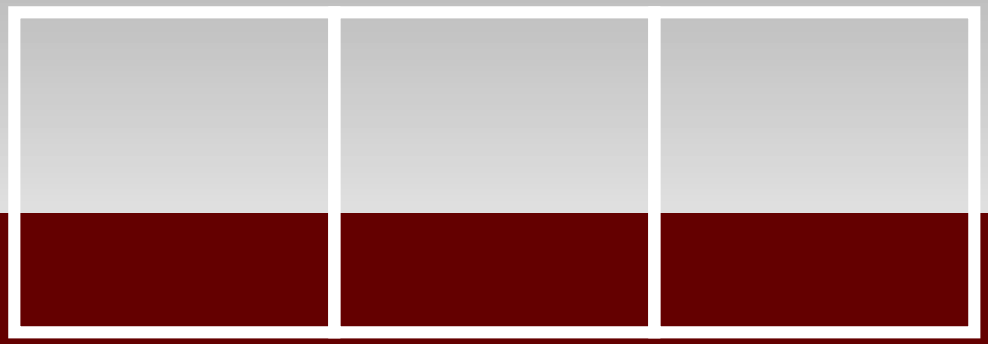
ü collaborated

ü integrated

Integrate the Risks Management Process

Integrated risk management process

Total dependency upon the normal performance control system



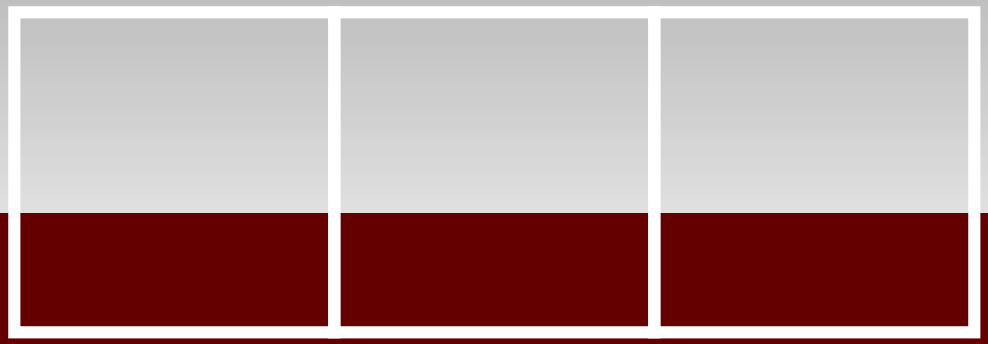
Rely on Clear and Reliable Project Metrics

- Ensure clear, realistic, and reliable definition of the project performance measurements and metrics

Reliable Measurements and Metrics

- Common problem
- Predictable world of cause and effects
- Major cause of project variances
  - lack of realism in initial planning and definition
  - delays underestimated
  - contingencies too low
  - geological and natural elements not clearly defined
  - environmental, safety and existing conditions unclear

ü can't measure, can't manage



Implement a Continuous Risk Management Process

- Continuously evaluate the effects of risks through the progress of the project work and intervening when necessary to ensure their mitigation and resolution

A Continuous Risk Process

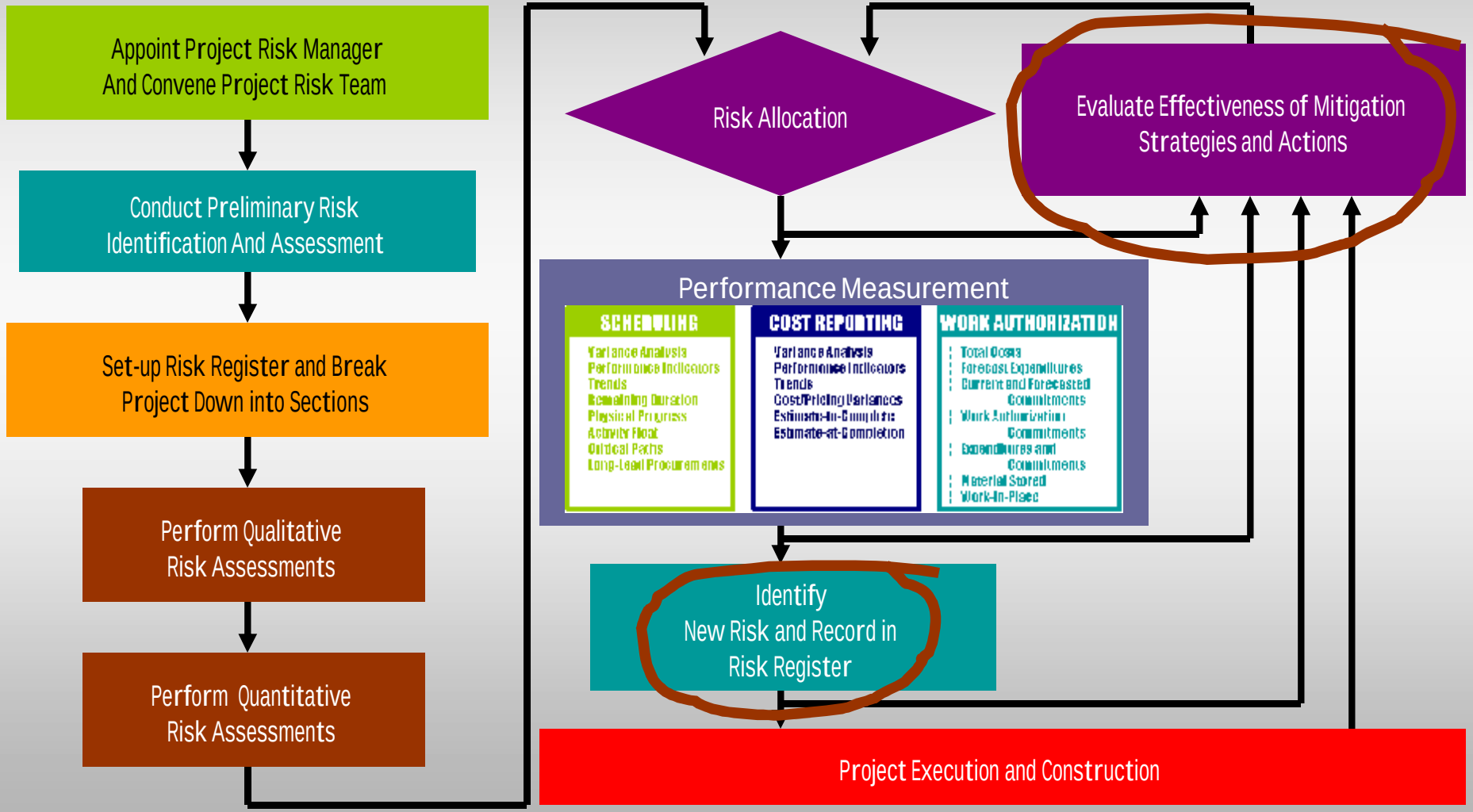
- Identifying additional risks as the project progresses
- Continuously gathering risk information and conducting reviews as the project progresses
  - reevaluating risks periodically
  - evaluations at the end of each milestone phase
- Continuously assessing the probability of occurrence and potential impact

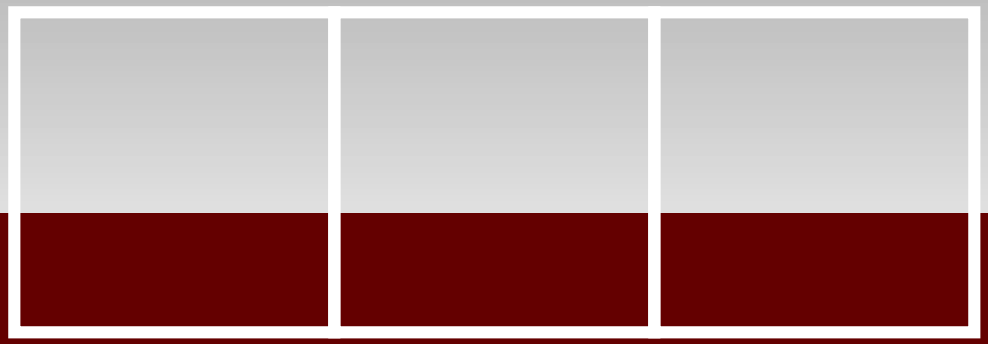
ü increase budget confidence

ü increase success confidence

A Continuous Risk Process

Continuing risk analysis with project management





Conclusion

- Risks cannot be eliminated
- Risks can be acknowledged and managed in a better method
  - measured and expressed a great deal better

Conclusion

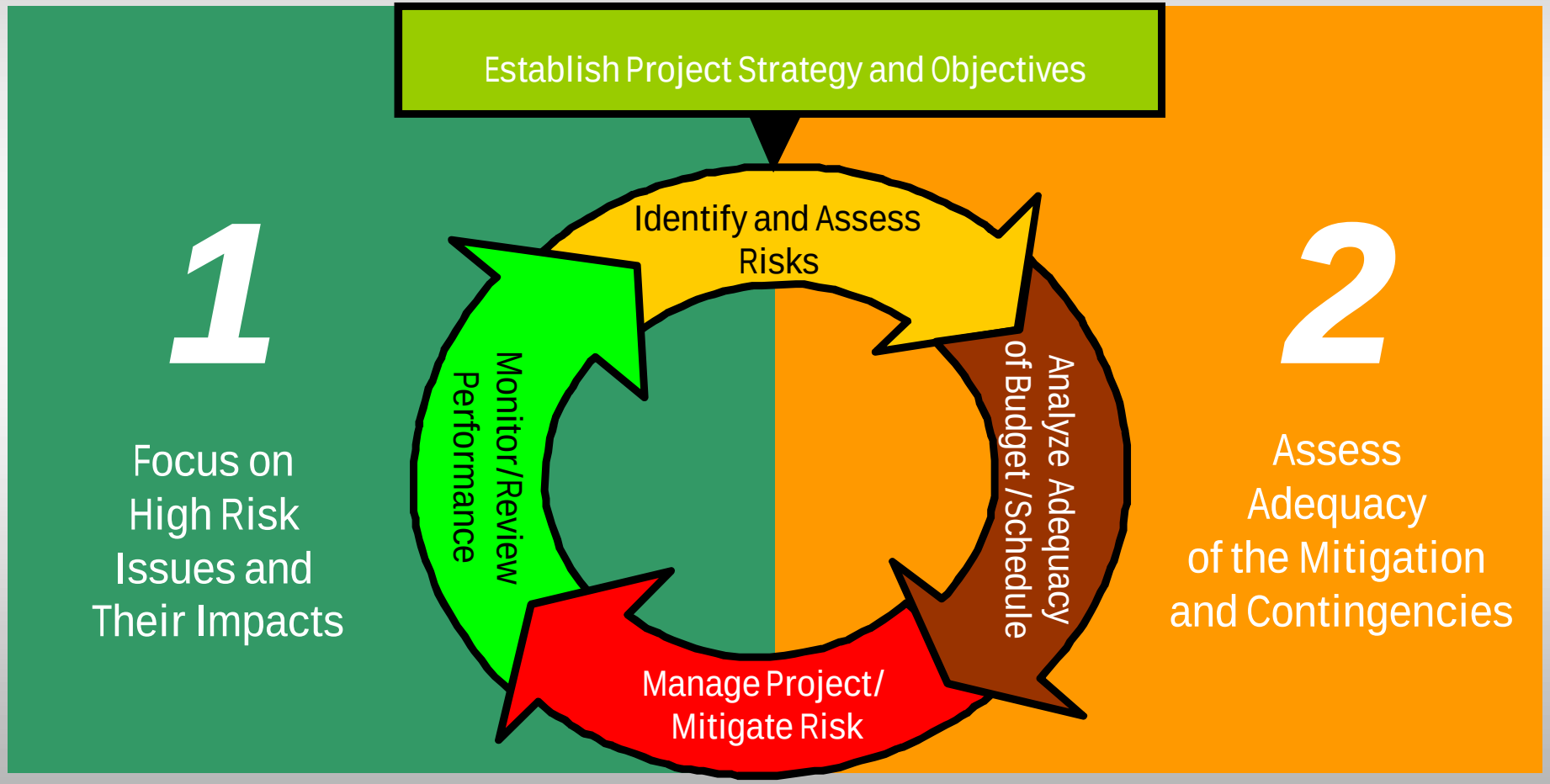
- Think in terms of the following
  - having a risk management process
  - identify risks elements and determine their effects
  - assign mitigation actions and strategies
  - use as another project management tool kit

ü keep watch on top risks

ü monitor and track performance results

A Continuous Risk Process

An iterative and continuous measuring and evaluation process



Conclusion

- Benefits of the risk management process
  - disciplined framework
  - avoided/reduced large losses
  - improved decision making
  - improved allocation of resources
  - increased project confidence

ü best method for owners interest protected

ü risks are balanced to adequate mitigation

Questions and Comments

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