Cost Engineering Support

for

SMART Planning

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Kim Callan,
Walla Walla Cost-MCX

3 April 2014

US Army Corps of Engineers
PLANNING SMART
BUILDING STRONG®

U.S. ARMY CORPS OF ENGINEERS
Institute for Water Resources

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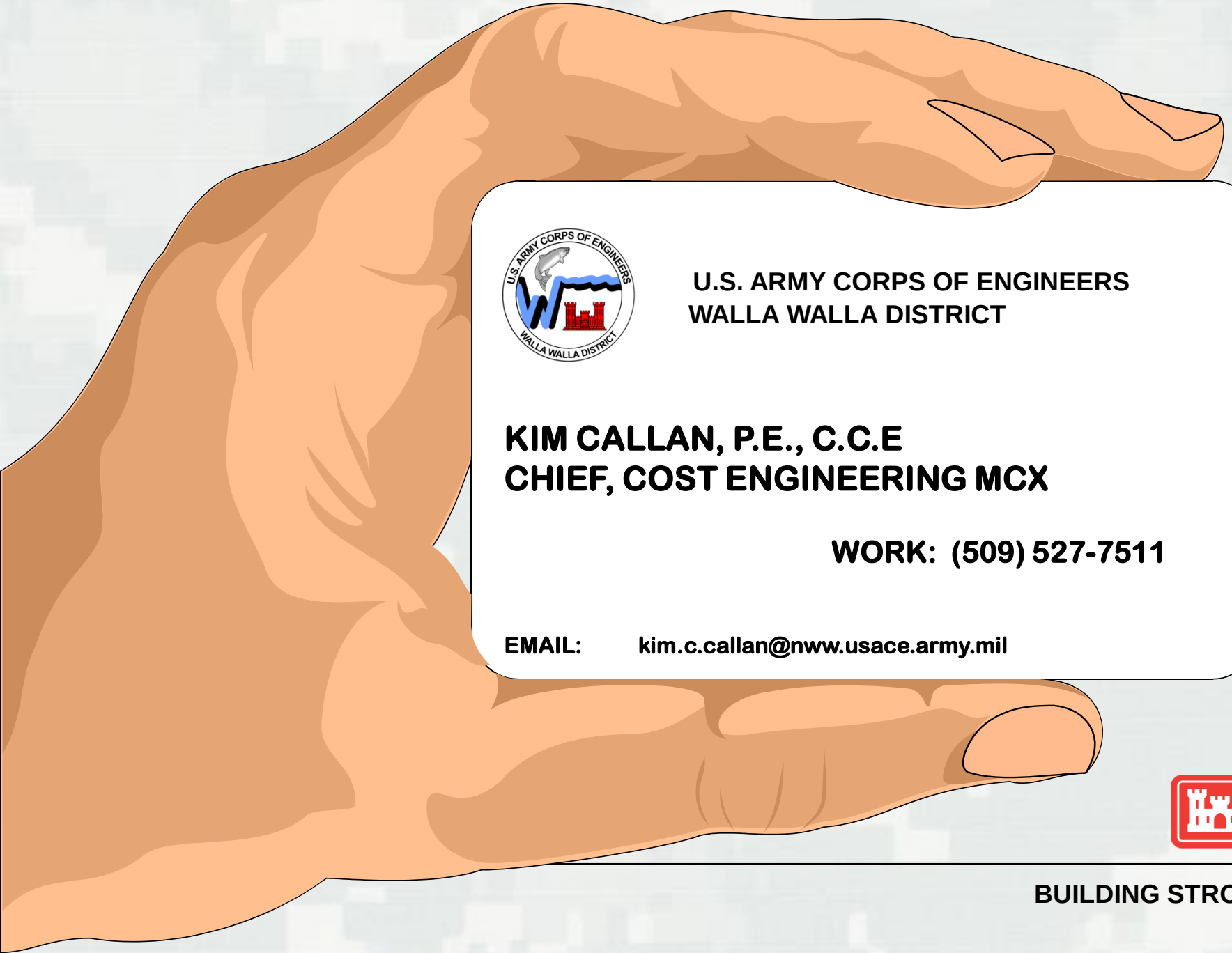

U.S. ARMY CORPS OF ENGINEERS
WALLA WALLA DISTRICT

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Outline

- Background (issues & concerns)
- SMART Planning (3x3x3) Process Flow Chart
- Cost Engineering Product Development
- SMART Planning Risk vs. Cost and Schedule Risk
- Cost ATR (When, What Level and by Who)

Objectives

Better Understand

- When and What level of detail of cost products in support of the SMART Planning process.
- Correlation between Planning Risk and CSRA Risk and how each can help each other.
- Cost ATR requirements of when and as to what level.

Background

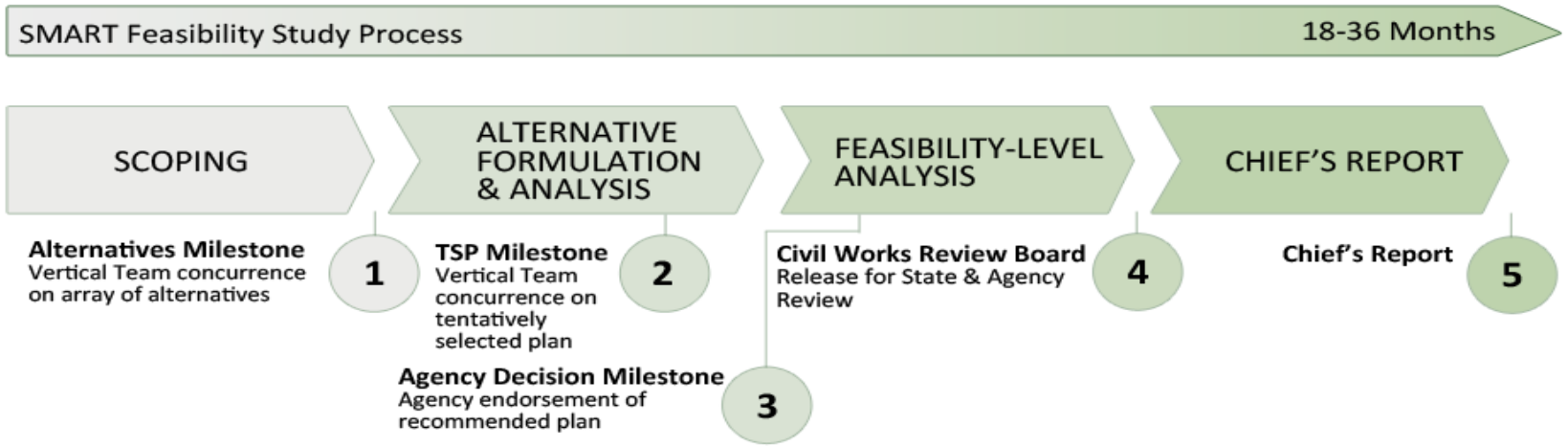
- Confusing Areas (too much vs. not enough)
  - Engineering Effort during SMART Planning
  - Level of Cost Development
  - Planning Risk Register vs Cost and Schedule Risk Register
  - Cost ATR requirements

Prior Webinars for Reference

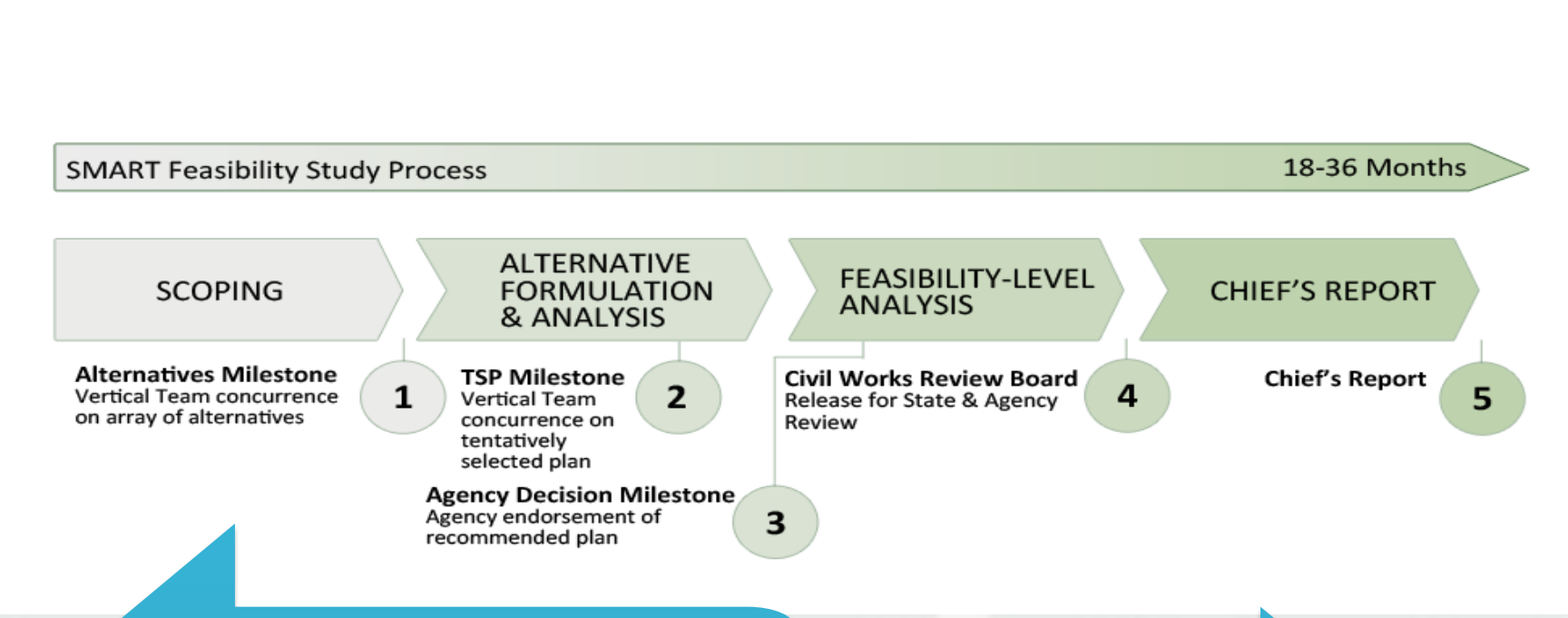
- Dec 2013 – Planning and E&C collaboration in Feasibility studies
- June 2012 and May 2013 - Planning Risk Registers
- Available at http://planning.usace.army.mil/toolbox/smart.cfm?Section=9&Step=1

SMART Planning Flow

Feasibility Study Process

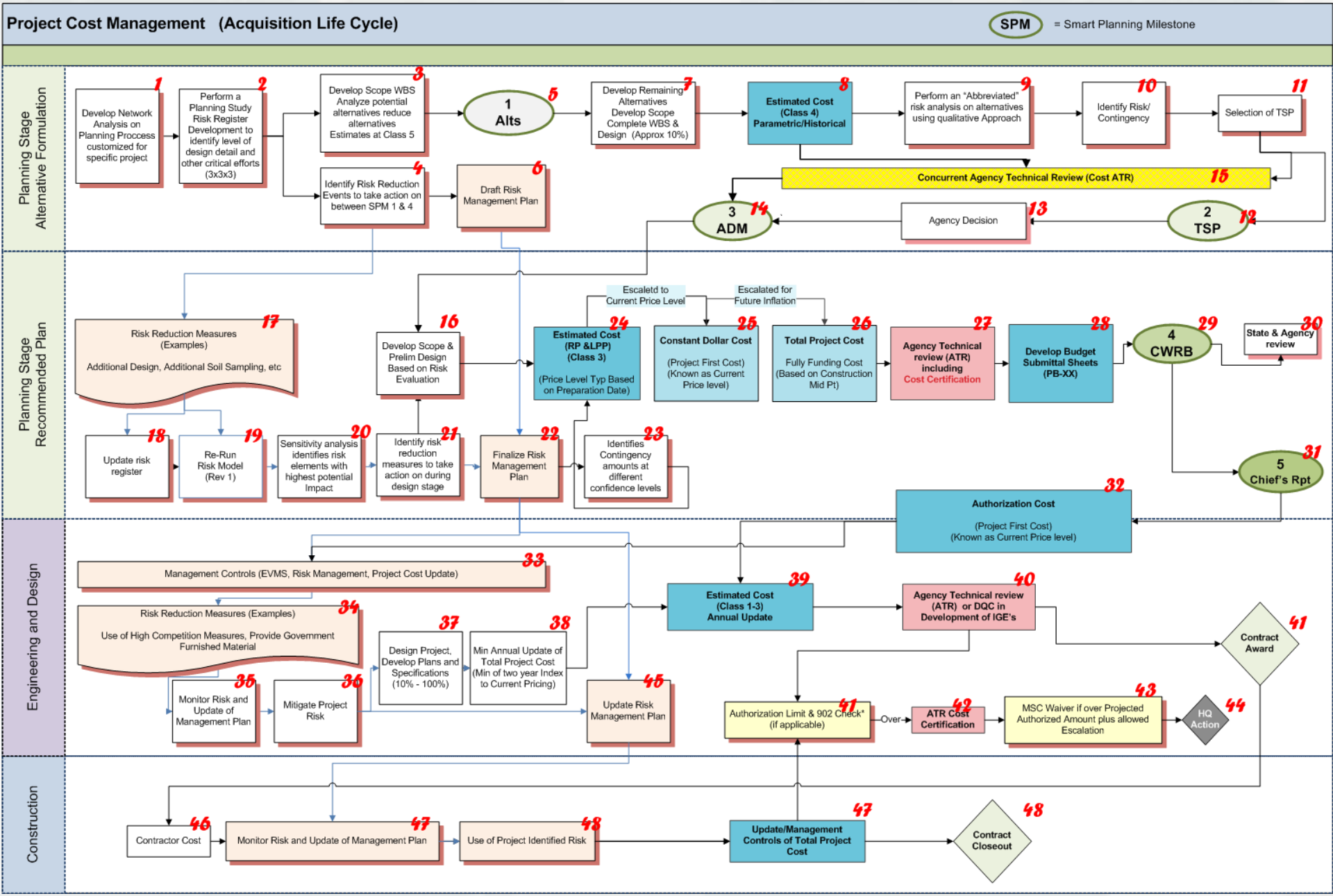


Planning and Engineering



Focus on alternatives evaluation to identify a tentative plan for more detailed design

Focus on scaling the measures and features for the recommended plan/LPP


Project Cost Management (Acquisition Life Cycle)
SPM = Smart Planning Milestone
Planning Stage Alternative Formulation
Planning Stage Recommended Plan
Engineering and Design
Construction
1 Develop Network Analysis on Planning Proccess customized for specific project
2 Perform a Planning Study Risk Register Development to identify level of design detail and other critical efforts (3x3x3)
3 Develop Scope WBS Analyze potential alternatives reduce alternatives Estimates at Class 5
4 Identify Risk Reduction Events to take action on between SPM 1 & 4
5 1 Alts
6 Draft Risk Management Plan
7 Develop Remaining Alternatives Develop Scope Complete WBS & Design (Approx 10%)
8 Estimated Cost (Class 4) Parametric/Historical
9 Perform an "Abbreviated" risk analysis on alternatives using qualitative Approach
10 Identify Risk/ Contingency
11 Selection of TSP
12 2 TSP
13 Agency Decision
14 3 ADM
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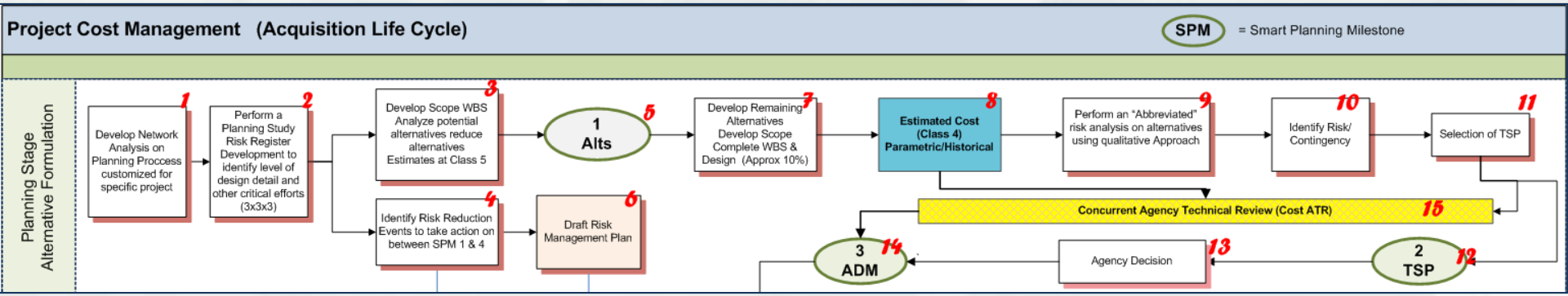
27 Agency Technical review (ATR) including Cost Certification
28 Develop Budget Submittal Sheets (PB-XX)
29 4 CWRB
30 State & Agency review
31 5 Chief's Rpt
32 Authorization Cost (Project First Cost) (Known as Current Price level)
33 Management Controls (EVMS, Risk Management, Project Cost Update)
34 Risk Reduction Measures (Examples) Use of High Competition Measures, Provide Government Furnished Material
35 Monitor Risk and Update of Management Plan
36 Mitigate Project Risk
37 Design Project, Develop Plans and Specifications (10% - 100%)
38 Min Annual Update of Total Project Cost (Min of two year Index to Current Pricing)
39 Estimated Cost (Class 1-3) Annual Update
40 Agency Technical review (ATR) or DQC in Development of IGE's
41 Contract Award
42 ATR Cost Certification
43 MSC Waiver if over Projected Authorized Amount plus allowed Escalation
44 HQ Action
45 Update Risk Management Plan
46 Contractor Cost
47 Monitor Risk and Update of Management Plan
48 Use of Project Identified Risk
47 Update/Management Controls of Total Project Cost
48 Contract Closeout
Authorization Limit & 902 Check* (if applicable)
Over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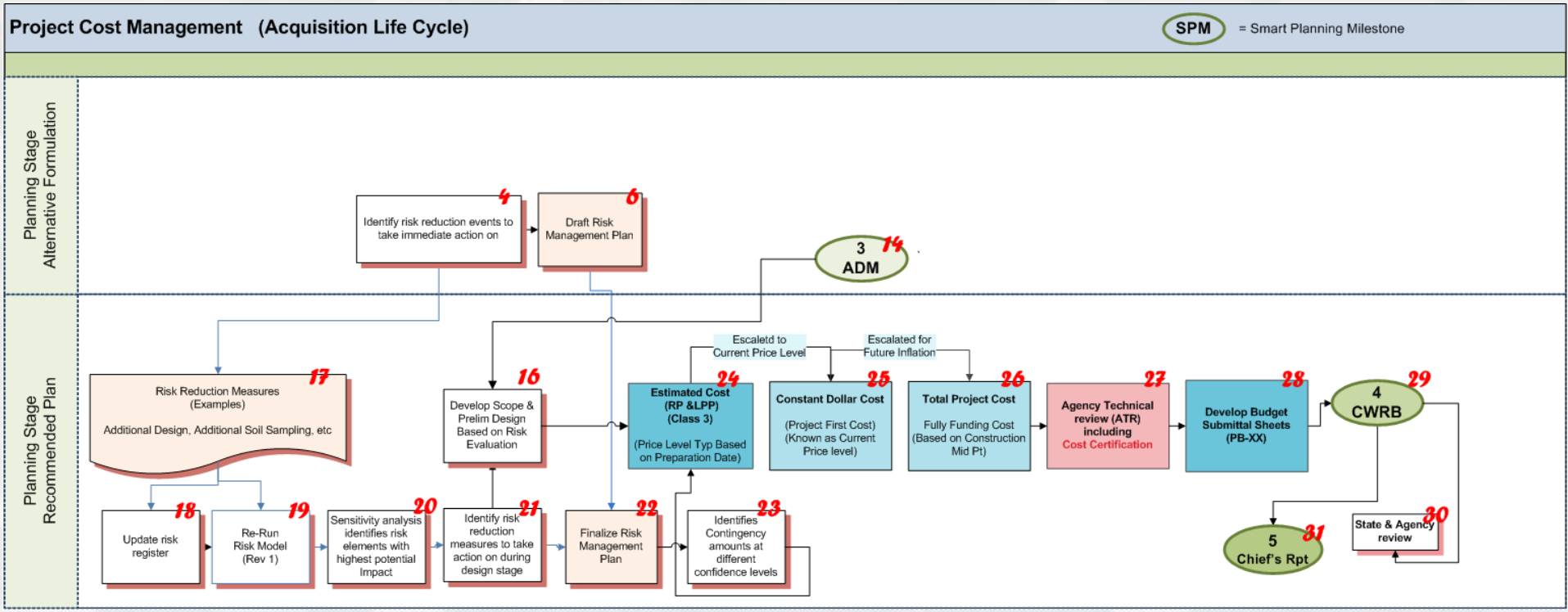

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ENGINEERING AND CONSTRUCTION BULLETIN No. 2012-18

5. Guidance: For all Civil Works studies utilizing the new paradigm as directed by reference a, Engineering & Construction (E&C) efforts will incorporate the following concepts:

a. Uncertainty and Level of Detail. The new paradigm will require increased use of critical thinking (i.e. engineering judgment) in the analysis and cost estimates supporting plan formulation and selection for both alternative level as well as final recommendation. The Project Development Team (PDT) must analyze minimum design requirements to assure functionality and life safety for the project. The PDT must also determine minimum design requirements needed to develop accurate cost and schedule information. The appropriate level of detail shall be determined with design personnel as the lead for determining design levels for function and safety, and cost personnel as the lead for the design detail requirements pertaining to cost and schedule development. Within the design effort in feasibility, the PDT will develop a work breakdown structure which sufficiently identifies the project scope, features, and tasks to a level necessary to develop an accurate baseline cost and schedule, and enables identification and management of cost and schedule risks. Each project will use a "risk register" organized by project features to assess their likelihood of impacting cost, schedule and/or function/safety. The goal is to minimize data collection and analysis for low impact features during the feasibility phase. High impact features should be carefully scoped such that data collection and analysis is commensurate with risk and adds value to the decision making process, accuracy to the cost and schedule, or reduces risk. The PDT shall work closely with the cost engineer to identify areas where design details would be beneficial to reduce uncertainty. For items with significant cost and schedule risk, mitigation strategies should be identified and/or discussed in the project's Risk Management Plan. While this approach must not lead us to accept additional life safety risk in projects, it may be appropriate to make a risk informed decision to defer some details or analysis to the Preconstruction Engineering and Design (PED) phase, provided that proper plan formulation can be accomplished.

Key Points

- Increased use of critical thinking (i.e. engineering judgment) in the analysis and cost estimates product development
- The appropriate level of detail shall be determined with
  - design personnel as the lead for determining design levels for function and safety, and
  - cost personnel as the lead for the design detail requirements pertaining to cost and schedule development.
- Full Scope Defined and Technical Information as needed.
- The PDT shall work closely with the cost engineer to identify areas where design details would be beneficial to reduce uncertainty. For items with significant cost and schedule risk, mitigation strategies should be identified and/or discussed in the project's Risk Management Plan.

Scope vs Technical Info (Design, ETC..)

- Scope as far as Authorization
- Scope of Estimate Development
  - How Built
  - How Big
  - Where At?
  - By Who?

Critical Thinking

- Typical Type Construction?
- Risk During Life Cycle?
- Key Risk?

- Cost Engineering vs Cost Estimating?

Cost Engineering Product Development

Cost Engineering Mission

"to focus USACE leadership on effective development, management, and control of cost estimates to ensure funds are adequately programmed, authorized and appropriated in all phases of the project. The USACE ability to provide quality project estimates is an essential element of our support to our customers and partners for the successful accomplishment of the project."

Source: ER 1110-1-1300 Engineering and Design Cost Engineering Policy and General Requirements, 3 – 26 - 1993

Types of Estimates
Acquisition Life Cycle Cost Uncertainty

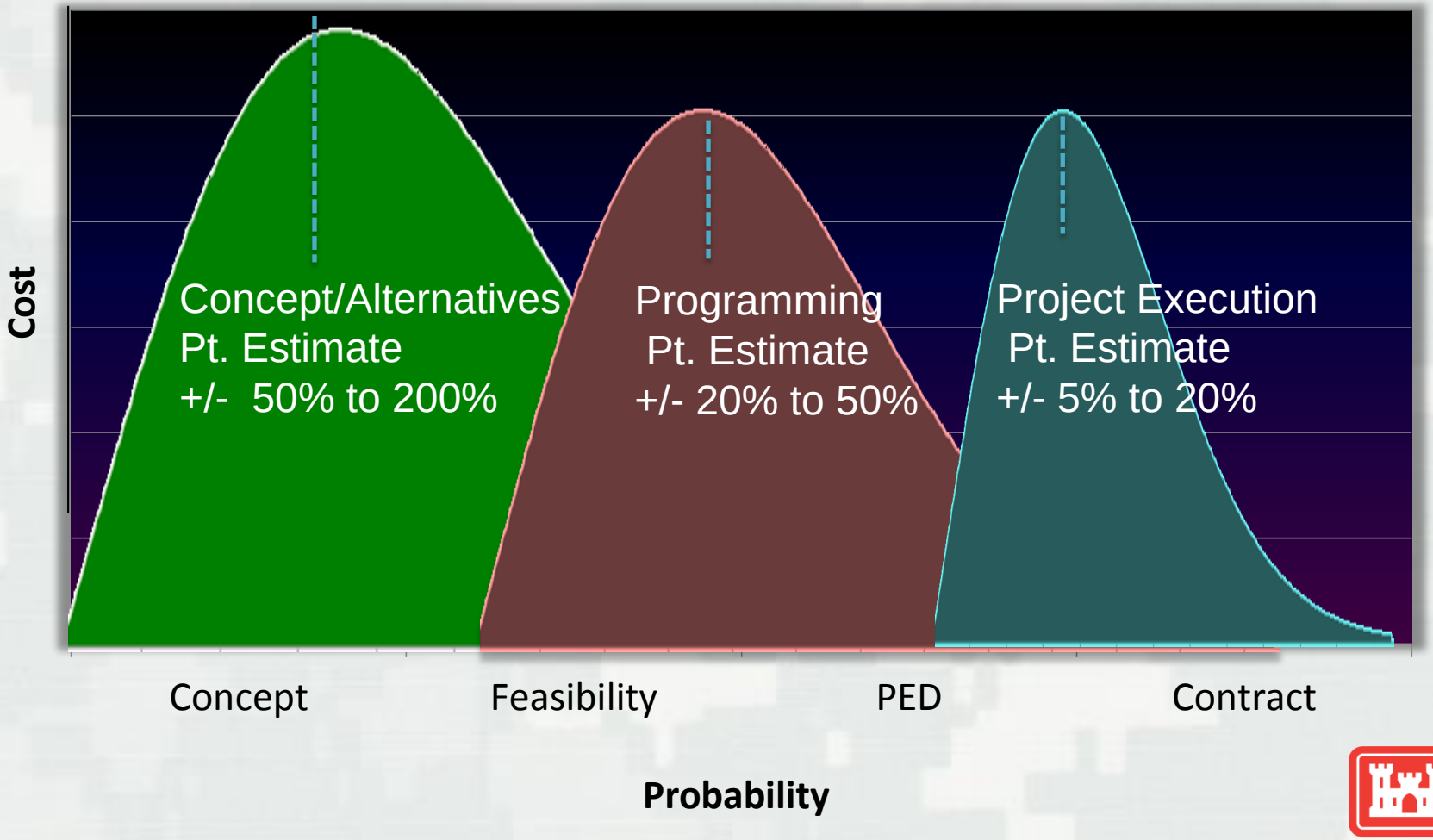

Table 1. ASTM E 2516-06, Standard Classification for Cost Estimate Classification System*

	Primary Characteristic	*Secondary Characteristic*			
ESTIMATE CLASS	**LEVEL OF PROJECT DEFINITION** Expressed as % of complete definition	**END USAGE** Typical purpose of estimate	**METHODOLOGY** Typical estimating method	**EXPECTED ACCURACY RANGE INDEX** Typical +/- range relative to best index of 1 [a]	**PREPARATION EFFORT INDEX** Typical degree of effort relative to least cost index of 1 [b]
Class 5	0% to 2%	Screening or Feasibility	Stochastic or Judgment	4 to 20	1
Class 4	1% to 15%	Concept Study or Feasibility	Primarily Stochastic	3 to 12	2 to 4
Class 3	10% to 40%	Budget, Authorization, or Control	Mixed, but Primarily Stochastic	2 to 6	3 to 10
Class 2	30% to 70%	Control or Bid/ Tender	Primarily Deterministic	1 to 3	5 to 20
Class 1	50% to 100%	Check Estimate or Bid/Tender	Deterministic	1	10 to 100

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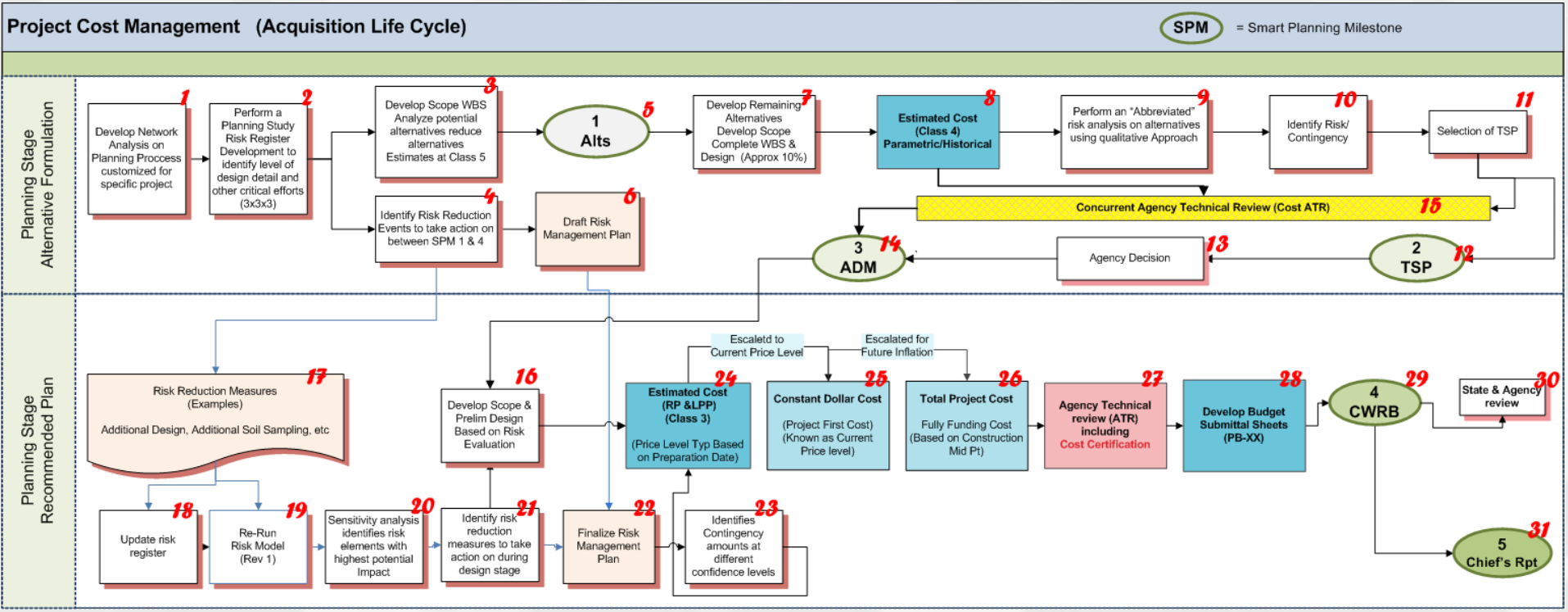
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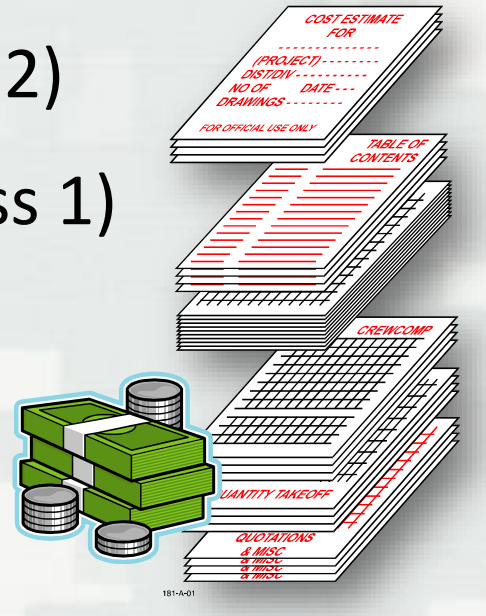
Types of Cost Estimates

ER 1110-2-1302, Civil Works Cost Engineering

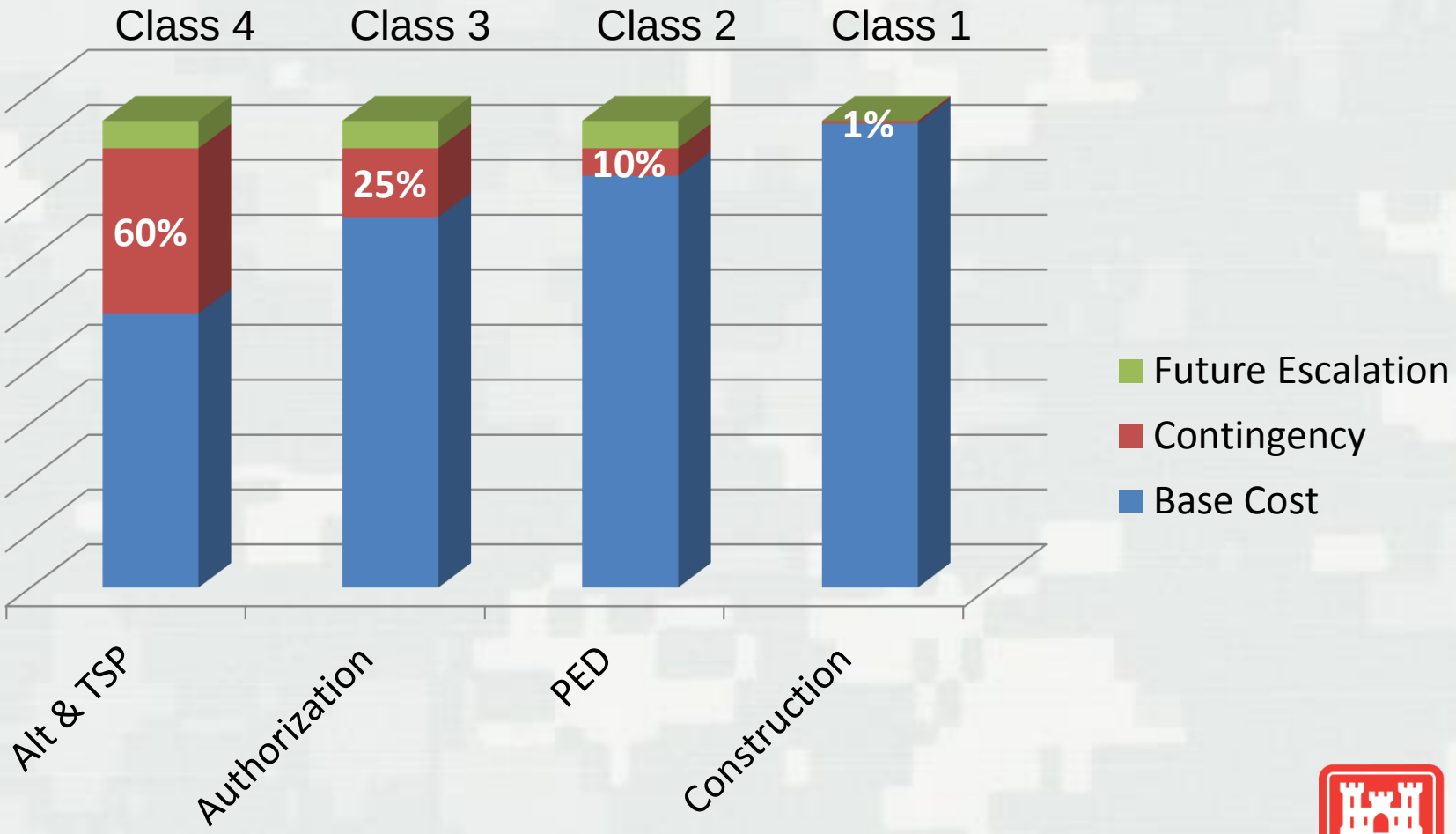
- Alternative Formulation Level (Class 4 and 5)
- Baseline/Programming Estimate (Class 3)
- Current Working Estimates (CWE) (Class 2)
- Independent Government Estimate (Class 1)
- Control Estimate (Class 2)



ER 1110-2-1302

Project Phase	Project Definition Scope	Risk Level	Minimum Estimate Class
Pre-Budget Development	**Extremely Limited**	**Extremely High**	**5**
Pre-Authorization			
Reconnaissance Alternatives	Very Limited	Very High	4
Feasibility Alternatives	Very Limited	High	4
Feasibility – Federally Recommended Plan	Limited-Fair	Moderate	3
Feasibility Locally Preferred Plan	Limited-Fair	Moderate	3
Funding Request Decision Documents	Limited-Fair	Moderate	3
Post Authorization			
Continuing Authorities Program	Limited	Moderate to High	3-4
Civil Emergency Management Program	Limited	Moderate to High	3-4
Alternative Studies	Limited	Moderate to High	3-4
Post Authorization Change Reports	Fair	Moderate	2-3
Funding Decision Documents	Limited-Fair	Moderate	3
Preconstruction, Engineering & Design (working estimates)			
PED 30%	Fair	Moderate	3
PED 60%	Fair-Good	Moderate to Low	2
PED 90%	Very Good	Low	1
IGE <100% Design	Fair-Good	Moderate to Low	2
IGE 100% Design	Very Good	Low	1
Construction / Post Award			
Budgets (modifications / claims)	Fair-Good	Moderate to Low	2
IGEs (modifications / claims)	Very Good	Low	1

Composite Estimate at Various Phases Example



Scope

- Spend the time…Nail down scope
- Assure all parties are on same page
- Define Options, Schedules, Restrictions

Contingency Analysis

- Risk
  - Scope
  - Contract Strategy
  - Cost
  - Schedule
  - Construction

What are the effects?

Planning Definitions

Memorandum: Civil Works Cost Definitions and Applicability. Aug 25, 2011

PURPOSE. This memorandum is intended to define and clarify cost terminology to be used in Chiefs Reports and other documents processed through the HQUSACE and or Office of the Assistant Secretary of the Army for Civil Works (ASA(CW)).

Summary

- Class 5 & 4 during early Alternative Stage
- Once TSP has been selected Class 3 required
  - This requires additional technical identification and cost development
- Base Cost plus Contingencies go hand and hand.

SMART Planning Risk vs. Cost and Schedule Risk (CSRA)

Planning Modernization 3x3x3

- **Planning Risk Register**
  - Evaluates the planning process for risk elements
    - study costs & schedule
    - benefits, costs, env & social impacts of alternatives
  - Helps identify areas of high risk and lower risk
  - Lower Risk Events are evaluated to be moved to later stages (ie design aspects)
- **Cost and Schedule Risk Register**
  - Evaluates the Project for risk elements which may cause a variance to cost, schedule or both.
  - Helps identify areas to mitigate in order to lower risk
  - Establishes Project Contingencies at Certain Confidence Levels

Planning Study Process Risk

- Planning Decision Risk Analysis
  - Identify uncertainties in critical decision information
    - Benefits; costs; environmental, social or cultural impacts; residual risks
  - Identify those that have greatest impact on decision quality
- Focus on areas that are critical in achieving the objective. This may be alternative designs or the TSP.

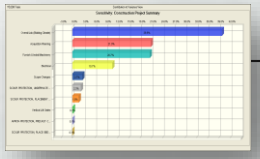
Risk in Planning Studies

Risk = *f(*Probability, Consequence)

- Study risk
  - Study delays, Study cost increase, Make a poor planning decision, Analytical error
- Implementation risk
  - Increased Probability of Inaccurate Decisions/Information
- Outcomes
  - Risk Mitigation
  - Acceptable Risk Carried Forward

Cost & Schedule Risk Analysis (CSRA)

- Tool used to communicate potential risk early in project development.
- Used to identify key areas for potential risk mitigation efforts and for development of project contingency.
- Formal analysis is required on all projects seeking authorization, anticipated to be $40 Million or more in total project cost. An abbreviated version is available for projects less than $40 Million.
- Analyzes at both cost and schedule of a project.



CSRA

- **Alternative Formulation**
  - Abbreviated Risk Model
  - or Detailed (if needed)
  - Qualitative
  - Does not produce confidence level outcomes
- **Baseline Development**
  - Detailed Risk Model
  - <$40M – Abbrev Risk Model
  - Quantitative
  - Does produce confidence level outcomes

Cost and Schedule Risk Analysis

- **ABBREVIATED VERSION**
  - Projects < $40M
  - Includes communication among PDT

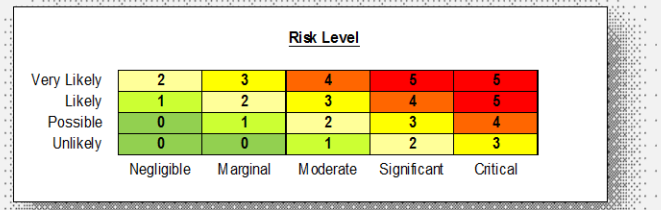
Abbreviated Risk Model

Project Example Alt A

Alternative Formulation

Abbreviated Risk Analysis

Meeting Date: 2-Apr-14



Risk Register

21%

Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level	Line Item Magnitude ($000)
Project Scope Growth				Maximum Project Growth		75%	
PS-3	Dredging	Basis in floating Clamshell, New Material, Difficult. Piling was discussed and eliminated based dredging density. 1-2 mile distance to disposal open water disposal.	Nearshore disposal requirement, due to depth, wave action, Can material be placed in proposed nearshore option.	Moderate	Very LIKELY	4	$20,000k
PS-4	Upland Facilities (performed by others)	Scope is utility replacement. Current basis is, elec is a swag.	Undefined scope concerning fuel and sewer. PDT will check and coordinate with estimator.	Marginal	Very LIKELY	3	$2,000k
PS-6	Sheetpile (performed by others)	Based on concept design, depth. File tip variation.	Potential for existing pile removal. Potential for boulders.	Moderate	Likely	3	$8,800k
Acquisition Strategy				Maximum Project Growth		30%	
Construction Elements				Maximum Project Growth		25%	
CE-3	Dredging	Standard type dredging of the Harbor, Have recent boring in the area to be dredged. Low chance of bedrock. Harbor is assumed clean and easy to dredge. Placement is designated.	Disposal area is risk, where and how, allowed by permits. Area is sensitive to public due to use for public mining of gold. Also, due to length of contract, will require turbity in area of disposal area. Fuel and equipment pricing can influence pricing.	Moderate	Very LIKELY	4	$20,000k
CE-5	Docks, Caison Dock (performed by others)	No foreseen additional risk. Estimate will include slower production for assembly. Remote location	Marginal risk due to remote location and working near water in a high climate location.	Marginal	Very LIKELY	3	$35,000k
CE-14	Construction Management	Potential for extended duration to excution schedule.	Allow for extended period of performance.	Moderate	Likely	3	$15,880k
Quantities for Current Scope				Maximum Project Growth		0%	
Specialty Fabrication or Equipment				Maximum Project Growth		75%	
Cost Estimate Assumptions				Maximum Project Growth		0%	
External Project Risks				Maximum Project Growth		0%	

Abbreviated Risk Model

Project Example Alt A
Alternative Formulation
Abbreviated Risk Analysis

Risk Evaluation

WBS	Potential Risk Areas	Project Scope Growth	Acquisition Strategy	Construction Elements	Quantities for Current Scope	Specialty Fabrication or Equipment	Cost Estimate Assumptions	External Project Risks	Cost in Thousands
10 BREAKWATERS AND SEAWALLS	Blue Berm Realignment	1	1	1	-	-	2	2	$131,200
12 NAVIGATION, PORTS AND HARBORS	Dredging	4	1	4	-	2	-	2	$20,000
19 BUILDINGS, GROUNDS, AND UTILITIES	Upland Facilities (performed by others)	2	1	2	-	-	2	2	$2,000
12 NAVIGATION, PORTS AND HARBORS	Docks, Caison Dock (performed by others)	2	1	2	2	-	2	2	$35,000
12 NAVIGATION, PORTS AND HARBORS	Sheetpile (performed by others)	3	1	2	2	1	2	2	$8,800
All Other	Remaining Construction Items	1	-	-	-	-	-	-	$3,000
30 PLANNING, ENGINEERING, AND DESIGN	Planning, Engineering, & Design	3	-	2	-	-	2	-	$29,760
31 CONSTRUCTION MANAGEMENT	Construction Management	-	-	3	-	-	-	-	$15,880
									$245,640
	Risk	$ 16,731	$ 3,889	$ 8,958	$ 1,452	$ 1,333	$ 8,572	$ 8,616	**$49,551**
								Total	**$295,191**

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Abbreviated Risk Analysis

Project (less than $40M): **Project Example** — **Alternative:** **Alt A**

Project Development Stage/Alternative: **Alternative Formulation**

Risk Category: **Moderate Risk: Typical Project or Possible Life Safety** — **Meeting Date:** **4/2/2014**

Total Estimated Construction Contract Cost = **$ 200,000,000**

	CWWBS	Feature of Work	Contract Cost		% Contingency	$ Contingency	Total
	01 LANDS AND DAMAGES	Real Estate	$ -		0.00%	$ -	$ -
2	10 BREAKWATERS AND SEAWALLS	Blue Berm Realignment	$ 131,200,000		14.77%	$ 19,376,762	$ 150,576,762
3	12 NAVIGATION, PORTS AND HARBORS	Dredging	$ 20,000,000		56.73%	$ 11,346,103	$ 31,346,103
4	19 BUILDINGS, GROUNDS, AND UTILITIES	Upland Facilities (performed by others)	$ 2,000,000		19.74%	$ 394,828	$ 2,394,828
5	12 NAVIGATION, PORTS AND HARBORS	Docks, Caison Dock (performed by others)	$ 35,000,000		23.06%	$ 8,069,552	$ 43,069,552
6	12 NAVIGATION, PORTS AND HARBORS	Sheetpile (performed by others)	$ 8,800,000		33.14%	$ 2,916,313	$ 11,716,313
12	All Other	**Remaining Construction Items**	**$ 3,000,000**	*1.5%*	2.37%	$ 71,143	$ 3,071,143
13	30 PLANNING, ENGINEERING, AND DESIGN	**Planning, Engineering, & Design**	$ 29,760,000		21.11%	$ 6,281,212	$ 36,041,212
14	31 CONSTRUCTION MANAGEMENT	**Construction Management**	$ 15,880,000		6.90%	$ 1,095,505	$ 16,975,505

Totals					
Real Estate	$ -	0.00%	$ -	$ -	
Total Construction Estimate	$ 200,000,000	21.09%	$ 42,174,700	$ 242,174,700	
Total Planning, Engineering & Design	$ 29,760,000	21.11%	$ 6,281,212	$ 36,041,212	
Total Construction Management	$ 15,880,000	6.90%	$ 1,095,505	$ 16,975,505	
Total	**$ 245,640,000**	**20%**	**$ 49,551,417**	**$ 295,191,417**	
			Base	**Mid-Pt**	**80%**
	Range Estimate ($000's)		$245,640k	$270,000k	$295,191k

Cost and Schedule Risk Analysis

- **CRYSTAL BALL VERSION**
  - Projects >= $40M
  - Includes communication among PDT

Results of Crystal Ball Output

- Most Likely Cost Estimate (Risk Based)
- Most Likely Project Schedule (Risk Based)

- Total Project Cost to 80% Confidence Interval
- Total Project Schedule to 80% Confidence Interval

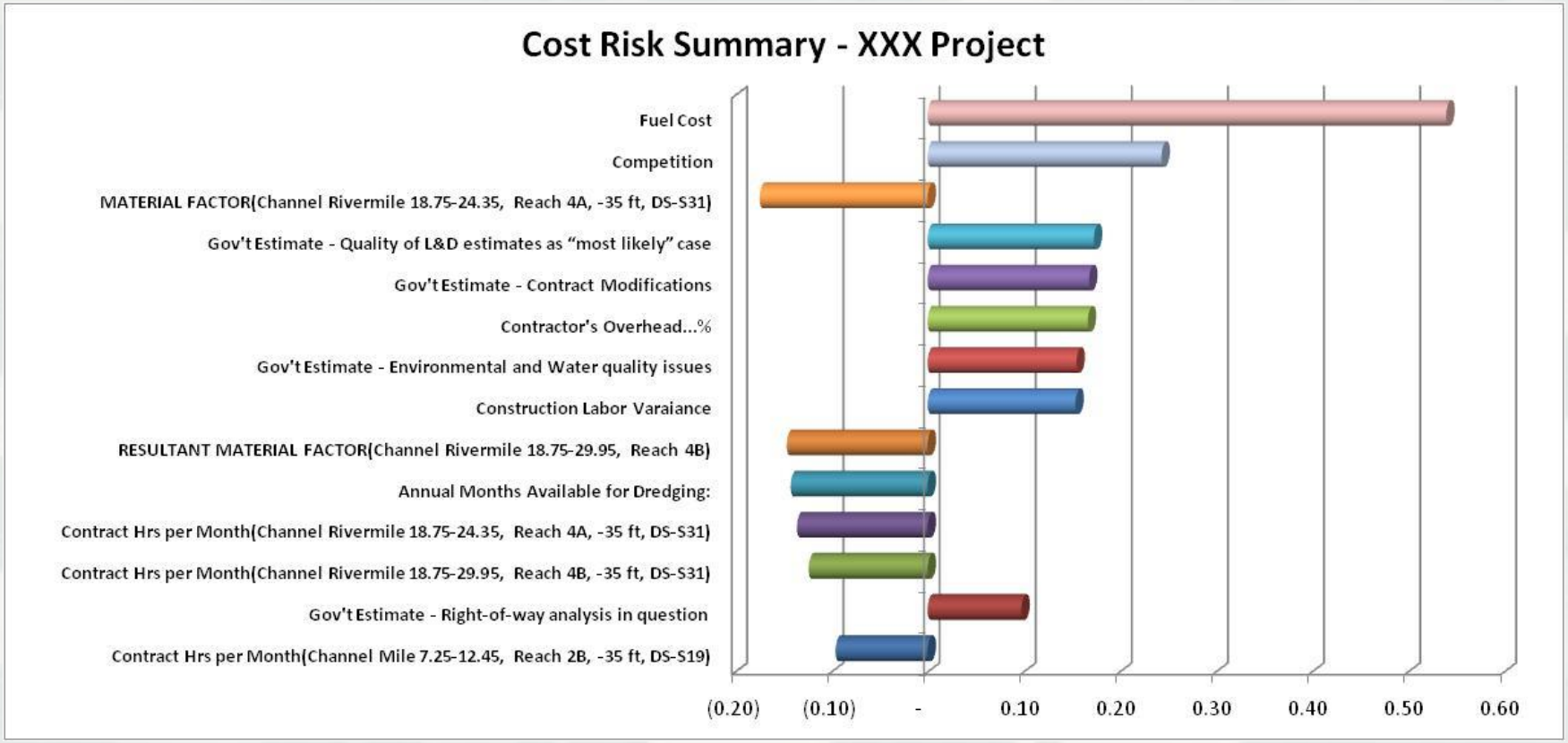
- Contingency for Total Project Cost Summary
- Sensitivity Analysis (Tornado Chart)

DEFINITIONS

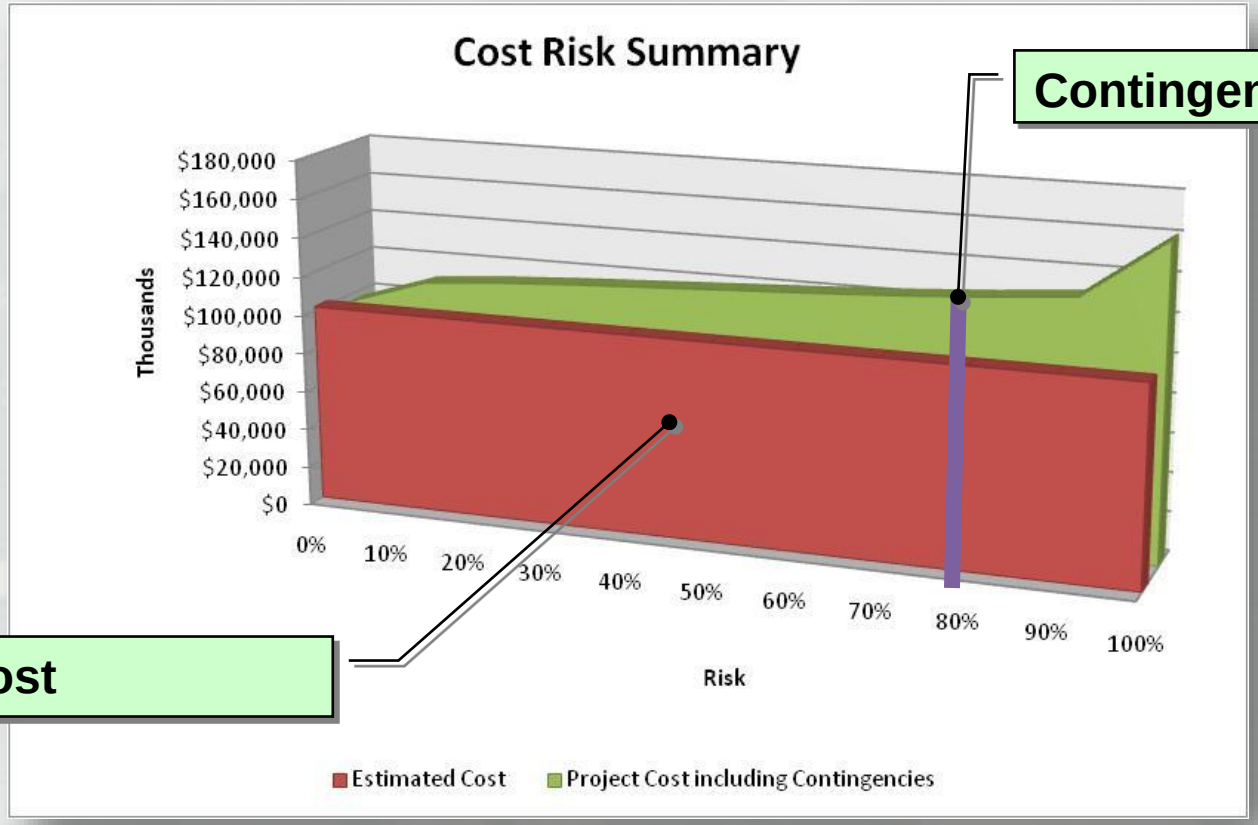
- Internal Risk: An item or activity upon which the PDT has control or influence.
- External Risk: An item or activity upon which the PDT has no control or influence.
- Discrete (Project, Contract, Specific) Risk: An item or activity that only affects a specific feature account.
- Global (Programmatic) Risk: An item or activity that affects multiple or all feature accounts.

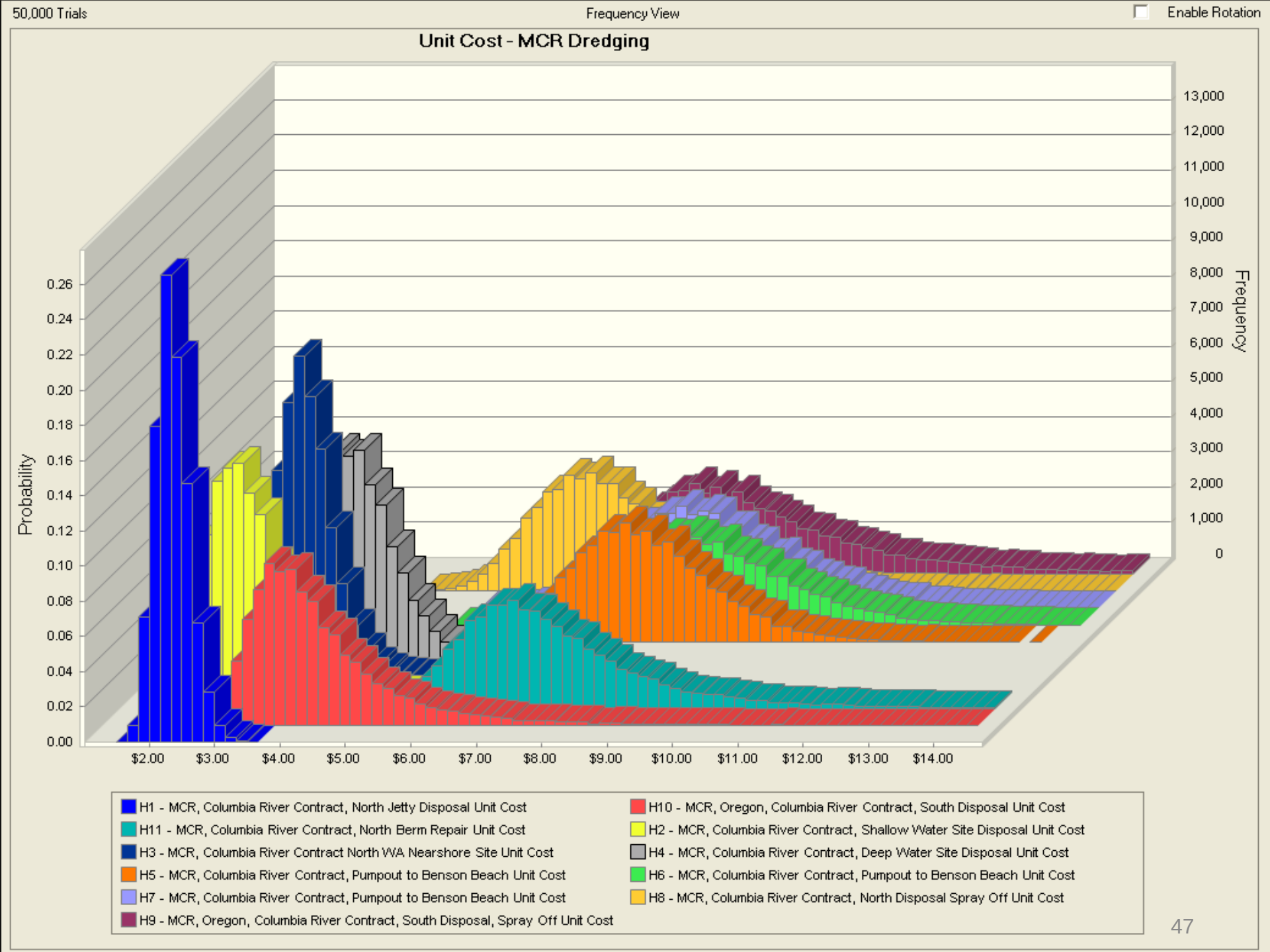
``				Project Cost			Project Schedule		
Ref #	Risk/Opportunity Event	Description	PDT Discussions	Likelihood ©	Impact ©	Risk Level ©	Likelihood (S)	Impact (S)	Risk Level (S)
Contract Acquisition (CA)									
38	Undefined acquisition strategy	Acquisition strategy is undefined to date	PDT is confident project will be solicited for maximum competition.	Unlikely	Negligible	Low	Unlikely	Negligible	Low
44	Contract Modifications	Typ risk for contract mod's	Assume typical risk for potential contract modifications, since this is dredging in areas that have not been previously dredged.	Likely	Marginal	Moderate	Likely	Marginal	Moderate
Technical Design (TD)									
47	Risk from Remaining Architectural Design	Confidence in scope, investigations, design, critical quantities	Through initial screening of potential risk, PDT has determined this Risk Element is not a factor for this Project	Unlikely	Negligible	Low	Unlikely	Negligible	Low
48	Risk from Remaining Geotechnical Design	Confidence in scope, investigations, design, critical quantities	Through initial screening of potential risk, PDT has determined this Risk Element is not a factor for this Project	Unlikely	Negligible	Low	Unlikely	Negligible	Low
49	Risk from Remaining Civil Design	Confidence in scope, investigations, design, critical quantities	Tight schedules, Little float in design schedule, high risk to meeting design milestones	Unlikely	Negligible	Low	Very Likely	Significant	High
50	Risk from Remaining Electrical Design	Confidence in scope, investigations, design, critical quantities	Through initial screening of potential risk, PDT has determined this Risk Element is not a factor for this Project	Unlikely	Negligible	Low	Unlikely	Negligible	Low
51	Risk from Remaining Mechanical Design	Confidence in scope, investigations, design, critical quantities	Through initial screening of potential risk, PDT has determined this Risk Element is not a factor for this Project	Unlikely	Negligible	Low	Unlikely	Negligible	Low
52	Risk from Remaining Structural Design	Confidence in scope, investigations, design, critical quantities	Through initial screening of potential risk, PDT has determined this Risk Element is not a factor for this Project	Unlikely	Negligible	Low	Unlikely	Negligible	Low
53	Risk from Remaining Environmental Design	Confidence in scope, investigations, design, critical quantities	Predredge Survey - Placements are ongoing. Potential for finding species which could halt project. If this occurs project is halted and therefore not modeled for contingency development	Very Likely	Significant	High	Very Likely	Significant	High
54	Risk from Remaining Controls Design	Confidence in scope, investigations, design, critical quantities	Benchmarks are being reestablished, as a result the overall qty of material could be effected.	Unlikely	Negligible	Low	Unlikely	Negligible	Low
55	Risk from Remaining Other Specialized Disciplines	Confidence in scope, investigations, design, critical quantities	Through initial screening of potential risk, PDT has determined this Risk Element is not a factor for this Project	Unlikely	Negligible	Low	Unlikely	Negligible	Low
69	Right-of-way analysis in question	Access to site through right of way	Access right of ways have not been granted. Lack of right away access would cause issues to disposal sites	Unlikely	Crisis	High	Unlikely	Crisis	High

Identify Sensitivity of Risk Elements



Confidence Levels and Contingency




50,000 Trials
Frequency View
Enable Rotation
Unit Cost - MCR Dredging
Probability
0.26
0.24
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Frequency
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
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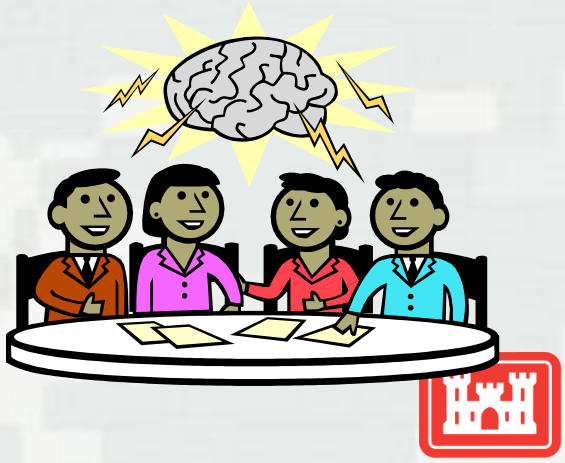
$12.00
$13.00
$14.00
H1 - MCR, Columbia River Contract, North Jetty Disposal Unit Cost
H10 - MCR, Oregon, Columbia River Contract, South Disposal Unit Cost
H11 - MCR, Columbia River Contract, North Berm Repair Unit Cost
H2 - MCR, Columbia River Contract, Shallow Water Site Disposal Unit Cost
H3 - MCR, Columbia River Contract North WA Nearshore Site Unit Cost
H4 - MCR, Columbia River Contract, Deep Water Site Disposal Unit Cost
H5 - MCR, Columbia River Contract, Pumpout to Benson Beach Unit Cost
H6 - MCR, Columbia River Contract, Pumpout to Benson Beach Unit Cost
H7 - MCR, Columbia River Contract, Pumpout to Benson Beach Unit Cost
H8 - MCR, Columbia River Contract, North Disposal Spray Off Unit Cost
H9 - MCR, Oregon, Columbia River Contract, South Disposal, Spray Off Unit Cost

RISK CONSIDERATIONS

- Organizational
- Project Management
- Contract Acquisition
- Technical Risks
- Estimates and Schedules
- Lands and Damages
- Regulatory
- Environmental
- Construction
- External Impacts



Base Cost vs Risk

- Will it most likely occur? – Base Cost
- Does it need risk mitigation efforts?

Pros to Risk Assignment

– Identify for PDT Risk Mitigation Efforts

Con's to Risk Assignment

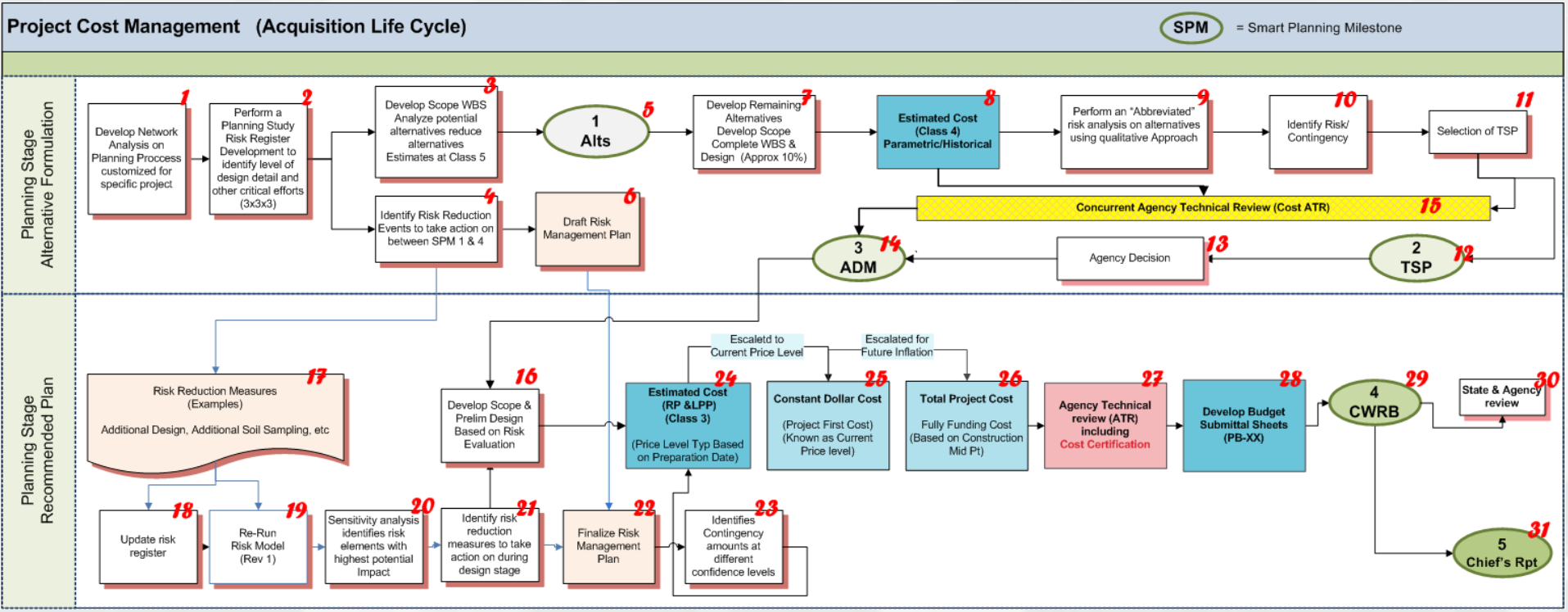
– High % Contingency

How Much % Contingency?

ER1110-2-1150, ENGINEERING AND DESIGN FOR CIVIL WORKS PROJECTS , 31 August 1999

- Contingencies for engineering costs during the feasibility phase shall be limited to the maximum extent possible; however, good engineering judgment shall be used in developing these contingencies.

Cost ATR


Project Cost Management (Acquisition Life Cycle)
SPM = Smart Planning Milestone
Planning Stage Alternative Formulation
Planning Stage Recommended Plan
1 Develop Network Analysis on Planning Proccess customized for specific project
2 Perform a Planning Study Risk Register Development to identify level of design detail and other critical efforts (3x3x3)
3 Develop Scope WBS Analyze potential alternatives reduce alternatives Estimates at Class 5
4 Identify Risk Reduction Events to take action on between SPM 1 & 4
5 1 Alts
6 Draft Risk Management Plan
7 Develop Remaining Alternatives Develop Scope Complete WBS & Design (Approx 10%)
8 Estimated Cost (Class 4) Parametric/Historical
9 Perform an "Abbreviated" risk analysis on alternatives using qualitative Approach
10 Identify Risk/ Contingency
11 Selection of TSP
12 2 TSP
13 Agency Decision
14 3 ADM
15 Concurrent Agency Technical Review (Cost ATR)
16 Develop Scope & Prelim Design Based on Risk Evaluation
17 Risk Reduction Measures (Examples) Additional Design, Additional Soil Sampling, etc
18 Update risk register
19 Re-Run Risk Model (Rev 1)
20 Sensitivity analysis identifies risk elements with highest potential Impact
21 Identify risk reduction measures to take action on during design stage
22 Finalize Risk Management Plan
23 Identifies Contingency amounts at different confidence levels
24 Estimated Cost (RP &LPP) (Class 3) (Price Level Typ Based on Preparation Date)
Escaletd to Current Price Level
25 Constant Dollar Cost (Project First Cost) (Known as Current Price level)
Escalated for Future Inflation
26 Total Project Cost Fully Funding Cost (Based on Construction Mid Pt)
27 Agency Technical review (ATR) including Cost Certification
28 Develop Budget Submittal Sheets (PB-XX)
29 4 CWRB
30 State & Agency review
31 5 Chief's Rpt

Cost ATR

- Smart Planning Milestone 1 (Alt's) through Milestone 2 (TSP)
  - Cost ATR Review, No Cost Cert, Thru Cost MCX
  - This review is a concurrent review with TSP development. Key focus of review is to assure alternatives have been properly developed for comparison basis. This aids in vertical team approval.
- Smart Planning Milestone 2 (TSP) through Milestone 4 (CWRB)
  - Cost ATR Review, Cost Cert Required, Thru Cost MCX
- Smart Planning Milestone 4 through Milestone 5 (Auth)
  - Re-Cost Cert (if changes), Thru Cost MCX

Tools

- Planning Community of Practice
  - SMART Guide
  - http://planning.usace.army.mil/toolbox/
- Walla Walla Cost MCX
  - General Cost Information
  - CSRA
  - Cost ATR
  - Website

http://www.nww.usace.army.mil/Missions/CostEngineering.aspx

Guidance

- Planning Guidance Notebook, ER 1105-2-100 Appendix G
- Civil Works Cost Engineering, ER 1110-2-1302
- Civil Works Construction Cost Index System, EM 1110-2-1304
- The US Army Corps of Engineers Civil Works Cost Definitions and Applicability Memorandum, 25 August 2012
- Methodology for Updating Benefit-to Cost Ratios (BCR) for Budget Development (CWPM 12-001)(draft)
- Certified Section 902 Tool
- EC 11-2-200, 31 May 2011 “Budget EC”
- BLS Consumer Price Index Series ID CUUR0000SEHA
- **EC 1165-2-209**, Civil Works Review Policy
- **ER 1110-2-1150**, Engineering & Design for Civil Works Projects
- **ER 1110-1-1300**, Cost Engineering Policy & General Requirements
- **ETL 1110-2-573**, E&D Construction Cost Estimating Guide For CW

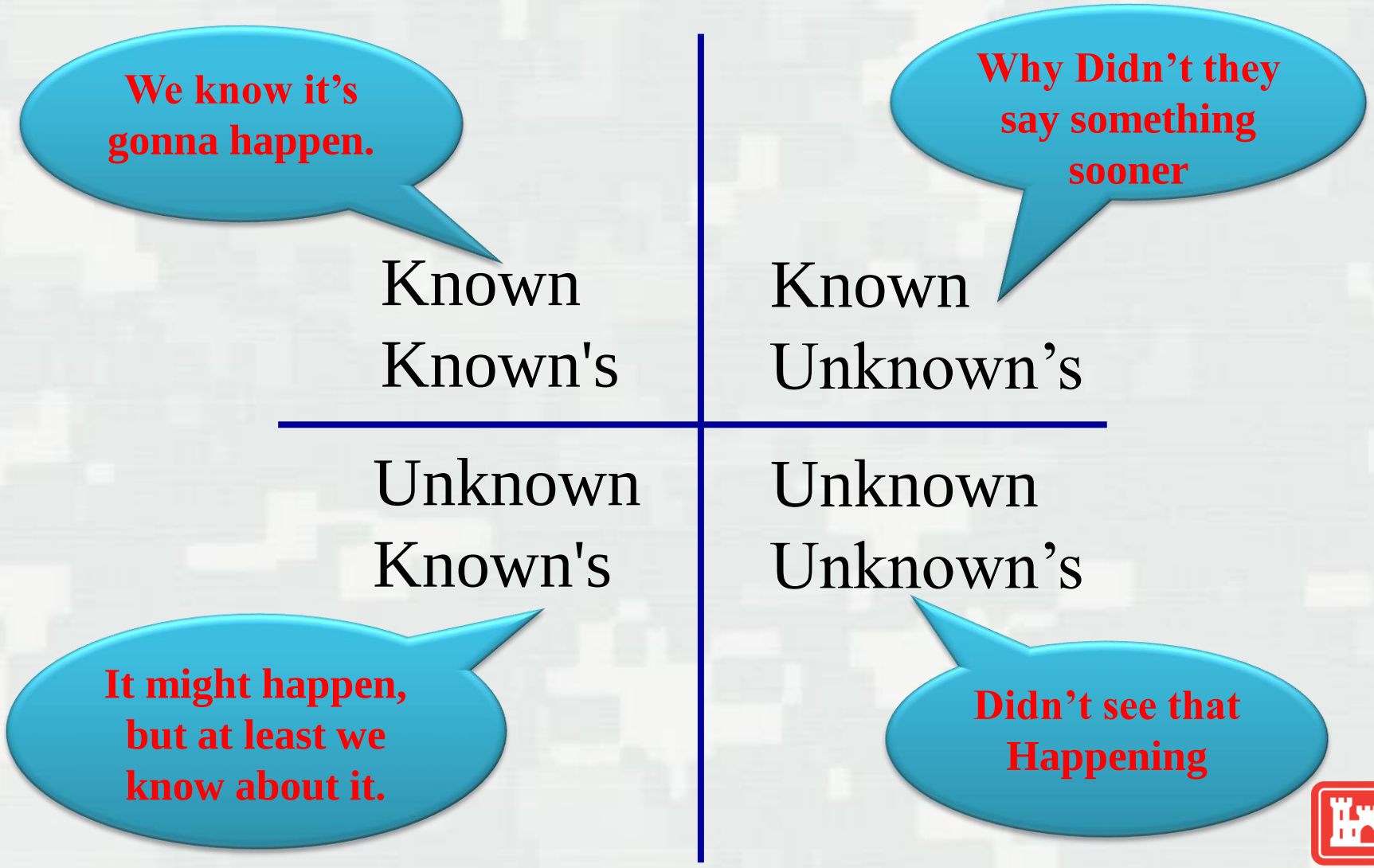
QUESTIONS??

US Army Corps of Engineers
PLANNING SMART
BUILDING STRONG®

BACKUP SLIDES FOR REFERENCE ONLY

Top Reasons for Major Cost Differences
Early Planning Level to Construction Award

BASIC RISK ASSUMPTIONS



WRDA 1986 Sec 902 (as amended) Maximum Cost of Projects

WRDA 1986 Sec 902 (as amended). Maximum Cost of Projects

In order to insure against cost overruns, each total cost set forth with respect to a project for water resources development and conservation and related purposes authorized to be carried out by the Secretary in this Act or in a law enacted after the date of the enactment of this Act, including the Water Resources Development Act of 1988, or in an amendment made by this Act or any later law with respect to such a project shall be the maximum cost of that project, except that such maximum amount –

(1) may be increased by the Secretary for modifications which do not materially alter the scope or functions of the project as authorized, but not more than 20% of the total cost stated for the project in this Act or any later law; and

(2) shall be automatically increased for---

(A) changes in construction costs applied to unconstructed features (including real property acquisitions, preconstruction studies, planning, engineering, and design) from the date of enactment of this Act or any later law (unless otherwise specified) as indicated by engineering and other appropriate cost indexes; and

(B) additional studies, modifications and actions (including mitigation and other environmental actions) authorized by this Act or any later law or required by changes in Federal law.

Source: ER 1105-2-100, Appendix G, Page G-78

Table G- 5 Section 902 Cost Limitation Action Matrix

IMPLEMENTATION STATUS AT TIME ESTIMATED TOTAL COSTS EXCEED SEC 902 LIMIT

	PRIOR TO EXECUTION OF THE PCA	*PCA EXECUTED, BUT NO CONTRACTS AWARDED*	*ONE OR MORE CONTRACTS AWARDED, FUTURE CONTRACTS/FUTURE PCA's*	*UNDER CONSTRUCTION LAST CONTRACT*
1. PROJECTS THAT HAVE ONE PCA, AND ONE CONTRACT	*1/*	*1/*	*N.A.*	*3/*
2. PROJECTS THAT HAVE ONE PCA, AND MULTIPLE CONTRACTS	*1/*	*1/*	*2/*	*3/*
3. PROJECTS THAT HAVE MULTIPLE PCAs AND MULTIPLE CONTRACTS	*1/*	*1/*	*2/*	*3/*

1. Await new legislation before proceeding with executing the PCA or award of the first contract if a PCA has already been approved.
2. Continue implementation of the project until implementation of the next PCA increment (or award of the next contract when the last PCA increment is already under construction) would require funds in excess of the 902 limit. Submit legislation to permit the authorization committees to consider inclusion of the legislative proposal in a biennial WRDA in time to prevent a break in project implementation whenever possible.
3. If completion of the current contract(s) would require funds in excess of the 902 limit, conclude current contract activities in the most practical and cost effective manner consistent with public safety and to minimize any obligations that exceed the 902 limit.

Source: Exhibit G-11. Project Cost Increase Fact Sheet
ER 1105-2-100, Appendix G, Page G-77

1. *Name of Project*
2. *Section and Law That Authorized or Modified the Project:*
3. *Section 902 Limit on Project Cost:*
    a. *Authorized project cost:(W/Price level)*
    b. *Price level increases from date of authorized cost: **
    c. *Current cost of modifications required by law: ***
    d. *20% of line 3a:*
    e. *Maximum project cost limited by Section 902:*
4. *Current Project Cost Including Inflation Through Construction: ****
5. *Computation of Percentage Increase:*
    a. *Current estimate: (Line 4)*
    b. *Less total of lines 3a, b, and c:*
    c. *Subtotal:*
    d. *Percent increase: (line 5c/3a)*
6. *Explain cost indexes used in 3b; whether national or regional for real estate, and single state or two state average for construction.*
7. *Explain increases in 3c; Legislation requiring the modification, and how accommodated.*
8. *Explain reasons for cost changes other than inflation.*
9. *Explain any changes in benefits and provide current BCR.*
10. *Provide detailed explanation of the status of the project.*

* *Line 1e from Table G-4, less the authorized cost.*

** *This includes cost of external credit under Section 104 of WRDA `86, for example. (Integral Section 104 credit is included in the authorized project cost on line 3a.) (See ER 1165-2-29).*

*** *Line 1b from Table G-4.*

Cost and Schedule Risk Analysis

Basis for the Risk Register development.

- Identify, mitigate and account for elements that could potentially cause a variance from estimated project cost and schedule.

Cost Products

- Estimate
- Schedule (minimum construction, all aspects)
- Cost and Schedule Risk Analysis

Cost Estimates – What They Mean to You

- Estimates are dependent on SCOPE!
- Estimates form the basis for decision-making (expectation management)
- All Civil Works Construction projects requiring authorization or ATR must have cost products certified by Civil Works Cost Dx (NWW)
- Cost Products are expected to be as accurate as possible

Schedules – What They Mean to You

- Estimates establish schedules, but schedules may also drive estimates.
- Schedules are also dependent on SCOPE!
- Schedules also aid in decision-making (expectation management)
- Schedules are expected to be as accurate as possible

Typical Risk Elements for thought

Organizational and Project Management Risks

- ❑ Project purpose and objectives are poorly defined
- ❑ Project scope definition is poor or incomplete
- ❑ Project schedule in question
- ❑ Product development by several sources or entities (virtual or remote efforts)
- ❑ Local agency/regulator issues
- ❑ Priorities change on existing program

Contract Acquisition Risks

- ❑ Undefined acquisition strategy
- ❑ Lack of acquisition planning support/involvement
- ❑ Preference to SDB and 8(a) contracts
- ❑ Acquisition planning to accommodate funding stream or anticipated strategy
- ❑ Numerous separate contracts
- ❑ Acquisition strategy decreasing competition
- ❑ Acquisition strategy results in higher scope risk (Design Build)

Technical Risks

- Design development stage, incomplete or preliminary
- Confidence in scope, investigations, design, critical quantities
  - Geotechnical
  - Civil
  - Structural
  - Mechanical
  - Electrical
  - Architectural
  - Environmental
  - Controls
  - Other Specialized Disciplines
- Inaccurate or risky design assumptions on technical issues
- Innovative designs, highly complex, first of a kind, or prototypes
- Incomplete studies (geotech, hydrology and hydraulic, structural, HTRW, etc)
- Surveys late and/or surveys in question
- Sufficiency / availability of as-built data / base map data
- Borrow/fill sources identified / secured
- Right-of-way analysis in question
- Lacking critical subsurface information for under-water / in-water work
- Hazardous waste concerns
- Need for design exceptions or waivers

Lands and Damages

- ❑ Real Estate plan defined
- ❑ Status of real estate / easement acquisition
- ❑ Objections to right-of-way appraisal take more time and/or money
- ❑ Ancillary owner rights, ownerships in question
- ❑ Relocations identified
- ❑ Known and unknown utility impacts
- ❑ Environmental mitigation needs identified
- ❑ Quality of L&D estimates as “most likely” case

Construction Risks

- ❑ Accelerated contract schedule
- ❑ Inefficient contractor
- ❑ Subcontractor capabilities
- ❑ Conflicts with other contracts
- ❑ Innovative project construction
- ❑ Timely delivery of critical GFE
- ❑ Permits, licenses, submittal approvals
- ❑ Permit and environmental work windows
- ❑ Environmental restrictions (equipment use, exhaust, paint fumes)
- ❑ Site access / restrictions (highways, bridges, dams, water, overhead / underground utilities)
- ❑ Adequate staging areas
- ❑ Rural / remote locale
- ❑ Inadequate skilled trades available for labor force
- ❑ Inadequate housing/utilities to support labor force
- ❑ Special equipment and equipment availability
- ❑ Material availability and delivery
- ❑ Productivity of critical work items
- ❑ Critical fabrication and delivery
- ❑ Unknown utilities
- ❑ Survey information
- ❑ Limited transportation / haul routes available
- ❑ Transportation / haul routes constricted or unusable during periods of time
- ❑ Unusual transportation haul distances
- ❑ Regulatory / operational work windows or outage periods
- ❑ Restricted schedule, accelerated schedule impacts
- ❑ In-water work
- ❑ Control and diversion of water
- ❑ Differing site conditions
- ❑ Unidentified hazardous waste
- ❑ Historic change order or modification growth
- ❑ Consideration for standard weather impact
- ❑ Adequacy of construction schedule depicting durations, sequencing, phasing, production rates

Estimate and Schedule Risks

- ❑ Estimate captures scope for all project features
- ❑ Estimate developed for current scope and design level
- ❑ Estimates developed in MCACES MII and/or CEDEP
- ❑ Estimate quality related to lesser designed features
- ❑ Estimate excludes contingency and escalation
- ❑ Estimate(s) quality when developed by others
- ❑ Estimate confidence in large and critical quantities
- ❑ Estimate include waste / drop off quantities
- ❑ Estimate reflects local market for labor and subsistence
- ❑ Estimate reasonableness of crews and productivities
- ❑ Estimate reflects local material costs and delivery
- ❑ Parametric estimates for unit prices adequate for critical items
- ❑ Consideration and local quotes for special equipment (cranes, barges, tugs, diving)
- ❑ Prime and subcontractor structure matches likely acquisition strategy
- ❑ Adequate schedule depicting all project features
- ❑ Schedule matches PED plan
- ❑ Schedule portrays critical construction features, matching estimate productivity
- ❑ Schedule depicts logical construction sequencing, phasing and parallel activities
- ❑ Estimate and schedule reflecting “most likely” occurrence
- ❑ Overall confidence in estimate and schedule

External Risks

- Adequacy of project funding (incremental or full funding)
- Priorities change on existing program
- Local communities pose objections
- Loss of public trust / goodwill
- Political factors change at local, state or federal
- Stakeholders request late changes
- New stakeholders emerge and demand new work
- Influential stakeholders request additional needs to serve other purposes
- Political opposition / threat of lawsuits
- Stakeholders choose time and / or cost over quality
- Market conditions and bidding competition
- Unexpected escalation on key materials
- Labor disruptions
- Acts of God (seismic events: volcanic activity, earthquakes, tsunamis; or severe weather: freezing, flooding or hurricane)