

San Francisco Peninsula Rail Program Executive Steering Committee

Item 7 - Downtown Rail Extension Project Quantitative Risk Analysis

November 18, 2022



Agenda

- Purpose of Quantitative Risk Assessment
- Contingency Development
- Quantitative Risk Assessment Process
- Project Cost Estimate Status

Purpose of the Quantitative Risk Assessment

The intent of the Quantitative Risk Assessment (QRA) at this stage is:

- Follow a structured, experienced-based process to guide project contingency values
- Convert the project teams' professional assessment of project risk (the Quarterly Risk Register) into contingency value recommendations
- Compare the QRA recommended allocated contingency (at a P80 level of confidence) to the designer's recommended cost estimate contingency

Contingency Development

Types of Contingency

	Definition	Percentage
Allocated	Design contingency by project element (cost category) for scope not captured in preliminary design	10% - 30% of Construction Cost ¹
Unallocated		
Construction	Contingency for measured construction work for unforeseen conditions and other changes	10% of Construction Cost ¹
Program Reserve	Contingency for all non-construction program requirements as well as a safety-net should escalation, claims, or change orders exceed the limits of the contingencies within the construction budget.	15% of Construction Cost + Program Costs ²

¹Construction Cost includes escalation to midpoint of construction

²Program costs includes professional services and right of way costs (escalated)

Quantitative Risk Assessment Process

Quarterly Risk Register

Example Risk Drivers:

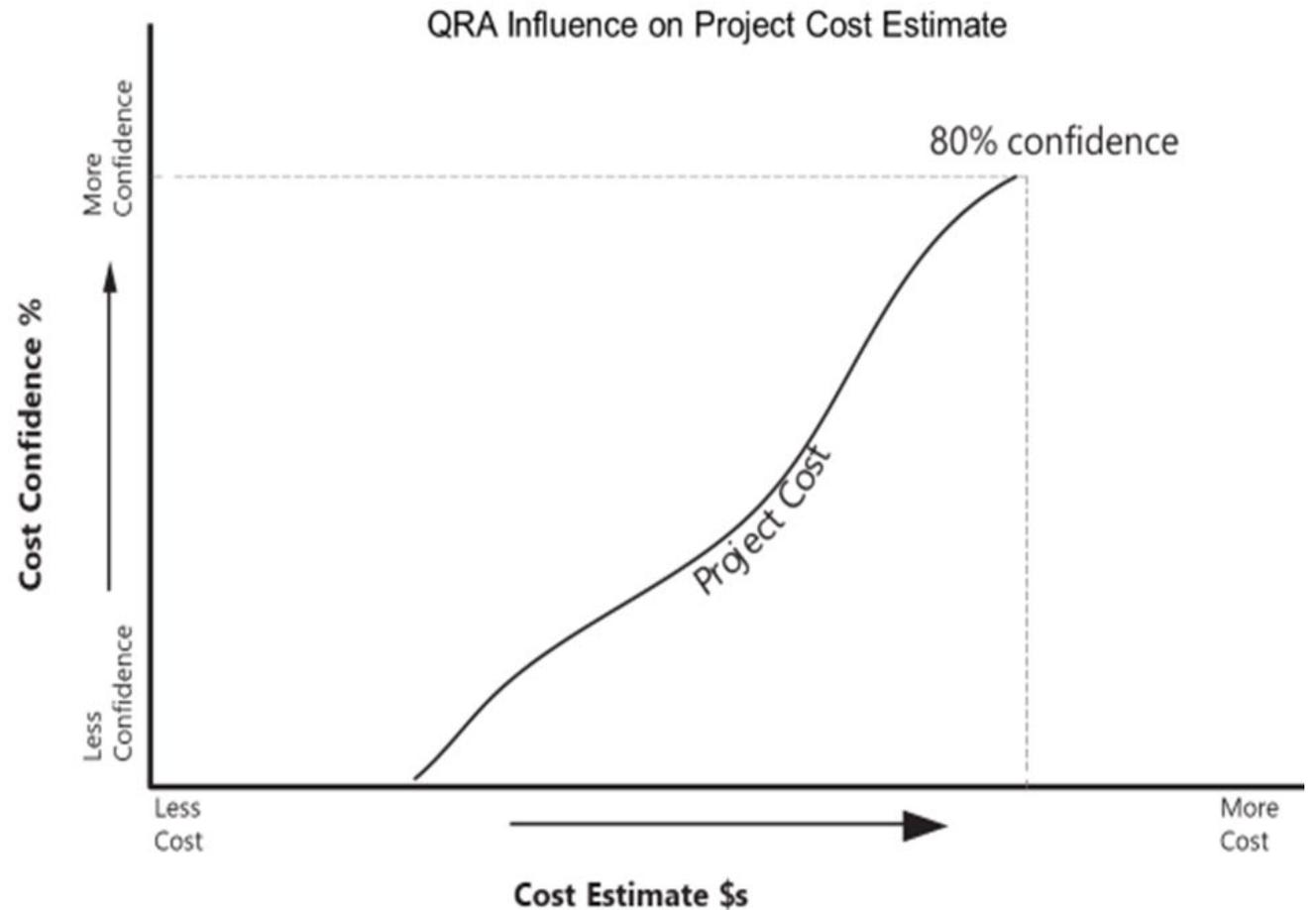
- Structural collapse in mined tunnel
- Scope adjustments for reconfiguration of DTX 4th & King Infrastructure Relocation
- Delays in property acquisition
- Delays due to unresolved design criteria
- Delay in Supervisory Control and Data Acquisition (SCADA) due to conflicts between Caltrain System and DTX

Risk / Opportunity Details				Initial State		Mitigated Risk State				Responsibilities									
Risk ID	RISK EVENT	RISK CAUSES / DRIVERS	POTENTIAL CONSEQUENCE	Opportunity (Op) Risk (Risk)	INITIAL ASSESSMENT					PROPOSED MITIGATION	POST-MITIGATION ASSESSMENT					DOCUMENT MITIGATION TO BE CAPTURED IN	ACTION BY	DATE REQUIRED	COMMENTS
					Probability	Life Safety	Schedule	Cost	Risk Score		Probability	Life Safety	Schedule	Cost	Risk Score				
500	CONSTRUCTION: General																		
501	Delays in delivery of critical equipment / materials (non pipe related)	- Roadheader, LDCC delays affect critical path schedule	- Delays during construction	Risk	2	1			2	- Confirm delivery timelines with vendors	2	1		2	Schedule	C Langford	1-Nov-20		
502	Delays in delivery of critical equipment / materials (pipes and valves)	- Delay in fabrication / delivery of pipe and / or valves (including poor quality or shipping / storage damage)	- Delays during construction	Risk	2	3			6	- Confirm delivery timelines with vendors	2	2		4	Schedule	A Le	1-Nov-20		
503	Poor quality / workmanship	- Inexperienced workers - Lack of construction supervision / management	- Rework leads to delays during construction and additional costs	Risk	3	2	2		6	- Include qualifications for Contractor's QC Manager - Include stringent quality requirements within the contractor's proposed work plans and hold points for approval of key areas - Provide full time inspectors as part of QA - Impose early requirements / meetings / letters with respect to Contractor milestones - Construction management, quality checks	2	2	2	4	RFQ Specifications	C Langford	1-Sep-22		
504	Damage to critical existing utilities/facilities during construction	- Improper protection / relocation completed ahead of construction	- Delays during construction - Loss of water supply COV and/or Park - Safety risk (e.g. pressurized water)	Risk	2	3	4	4	8	- Carry out pre-construction surveys / inspections of sensitive utilities - Early engagement of utility providers to define acceptable loading requirements - Prepare dwgs with locations, load restrictions etc. - Include reference mitigation designs (remove and replace CA4, structural slab) as part of design docs and payment items with submittals so this is not missed - Require shoring approach that minimizes settlement for structures near critical infrastructure (secant piles) - Undertake identification and protection of utilities as part of an early works contract	2		2	3	6	Design Dwgs Specifications	C Langford	16-Oct-20	Mar 27, 2020: critical utilities being identified as part of 60% design. Will then proceed with protection/relocation design between 60-90%. Risk to be revisited at next workshop. Jun 19, 2020: MV to look into the process / timing to inspect the West End Interceptor No. 1 before the end of design (summer months likely to be preferred) Sept 27, 2020: additional steps taken to mitigate this risk. Will discuss at risk workshop.
506	Damage to existing utilities during construction - other (minor)	- Improper protection / relocation completed ahead of construction	- Delays during construction - Cost to replace - Safety risk (e.g. gas lines)	Risk	4	1	2		8	- Carry out pre-construction surveys - Restrict loads over critical infrastructure - Prepare dwgs with locations, load restrictions etc. - Include reference mitigation designs as part of design docs and payment items with submittals so this is not missed - Use shoring approach that minimizes settlement for structures near critical	2		1	2	4	Design Dwgs Specifications	A Le	16-Oct-20	

Quantitative Risk Assessment Process

Quantitative Risk Analysis

- Produces a numeric estimate of the overall effect of risk on the project cost and schedule
- Considers both known and unknown risks
- Examines confidence levels and provides the basis for choosing contingency levels
- 80% confidence typically used for this project scope and level of development



Questions

