



REPORT

Update to Peer Review Group of work in progress on Risk Management

Objectives and Methodology on the California High-Speed Rail Program

San Francisco
July 9th, 2013

FINAL

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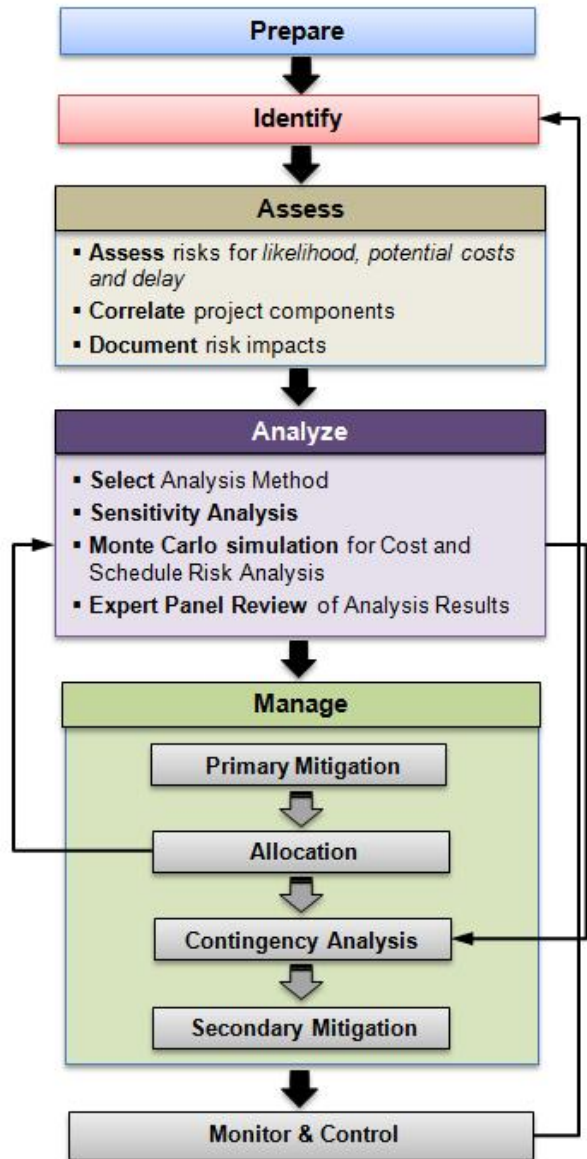
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The RMP defines how the Authority will identify, quantify and manage risks on the CHSTP. Based on the PRG's recommendations, the legislature included the following requirements in SB 1029 that the RMP has been developed to provide:

- A process by which identified risks will be quantified in financial terms
- Development documents that will be used to track identified risks and related mitigation steps
- Plans for regularly updating its estimates of capital and support costs
- Plans for regularly reassessing its reserves for potential claims and unknown risks, incorporating information related to risks identified and quantified through its risk assessment processes
- Plans for regularly integrating estimates for capital, support costs, and contingency reserves in required reports

The objectives of the Risk Management Plan are to:

- 1 Systematize the process by which the Authority responds to circumstances that could increase the cost or significantly delay or halt the Program
- 2 Increase transparency regarding challenges to project plans and objectives
- 3 Capture project opportunities
- 4 Satisfy legal and regulatory requirements and meet the needs and expectations of other stakeholders
- 5 Rationalize allocation of resources including cost and schedule contingencies



Risk Management Process

The risk management process is a 'living', iterative process that provides a structured, systematic procedure for managing risks

Foundation: Objectives, resources and basis documents

Characteristics of 'good' estimates:

- ▶ Accurate: unbiased, not overly conservative or overly optimistic, and based on an assessment of most likely costs.
- ▶ Comprehensive: all possible costs are included in sufficient detail to ensure that costs are neither omitted nor double counted.
- ▶ Well-documented: thoroughly documented and includes source data and significance, clearly detailed calculations and results, and explanations for choosing a particular method or reference.
- ▶ Credible estimate discusses any limitations of the analysis from uncertainty or biases surrounding data or assumptions.

Prepare	Establish objectives for risk analysis and expected outcomes.
	Identify resources available and resources required
	Perform comprehensive review of base project scope, cost and schedule to validate reasonableness.
	Establish the project's base cost and schedule (base excludes contingencies that are not specific allowances for known but unquantified project elements). Risks costs and risk delays are added to the base.
	<i>Product(s): Scope, Cost, and Schedule Review (report on reasonableness and accuracy of scope, cost and schedule of project) Estimate of Base Project Costs and Durations (table of adjusted base costs and durations allocated to project components)</i>

Identification

Identify	Establish a comprehensive and non-overlapping list of possible risks to the project.
	Ensure all project components (major activities, contract units) are evaluated for risks and opportunities. Opportunities represent actions or measures that could reduce costs and delays as opposed to risks that increase costs and delays.
	<i>Product: Draft Risk Register</i>

- ❑ Early Identification
- ❑ Iterative and Emergent Identification
- ❑ Comprehensive Identification considering Multiple Perspectives
- ❑ Relevant to Program Objectives

- ▶ Socio-political risks
- ▶ Financial risks
- ▶ Planning and design risks
- ▶ Environmental concerns
- ▶ Right-of-way acquisition
- ▶ Permitting requirements
- ▶ Third party agreements
- ▶ Technology applications, availability, and reliability
- ▶ Procurement requirements (vehicles, civil facilities, systems equipment, materials)
- ▶ Construction risks, including maintenance of traffic, changed conditions, utilities and subsurface conditions, etc.
- ▶ Other risks, such as acts of God (weather, etc.) and changes in regulatory conditions or market conditions

Assessment

Threat Impact Level	Cost Increase	Schedule Increase
Very High (5)	> \$ 100 M	6 Months and above
High (4)	\$ 50 M to \$ 100 M	4 to 6 Months
Medium (3)	\$ 10 M to \$ 50 M	2 to 4 Months
Low (2)	\$ 1M to \$10 M	1 to 2 Months
Very Low (1)	< \$ 1M	1 Week to 1 Month
Probability Level	Probability of Occurrence	
Very High (5)	90 - 99%	
High (4)	65 - 89%	
Medium (3)	36 - 64 %	
Low (2)	11 - 35 %	
Very Low (1)	1 - 10%	
Opportunity Impact Level	Cost Reduction	Schedule Reduction
Very High (5)	> \$ 100 M	6 Months and above
High (4)	\$ 50 M to \$ 100 M	4 to 6 Months
Medium (3)	\$ 10 M to \$ 50 M	2 to 4 Months
Low (2)	\$ 1M to \$10 M	1 to 2 Months
Very Low (1)	< \$ 1M	1 Week to 1 Month

Assess	Assess risks in terms of their likelihood of occurring and their potential costs and delay impacts when they do occur. Prior to designation of preferred alignment, risks will be assessed
	Estimate cost and schedule (i.e., duration) impacts of risks
	Identify correlated project components, that is, activities whose costs or durations move together in response to a risk event.
	Document estimated risk impacts on individual project
	Product: Completed Risk Register

Prior to designation of a preferred alignment: qualitative assessments for likelihood and cost, schedule, scope and quality impacts.

Following designation: quantitative assessments for both probability and cost and schedule impact.

Any applicable correlations between risks will be specified.

(Quantitative) Analysis

Analyze	<p>Select the appropriate analysis method for estimating impacts of multiple risks on the project cost and/or schedule. This involves combining risks impacts depend upon the objective: (probable costs, probable durations) to obtain the risk cost or delay to a project. The method will depend upon the objective:</p> <ul style="list-style-type: none"> ● Evaluate risk cost impacts to the base project cost [Independent cost analysis] ● Evaluate risk delay impacts to the base project schedule [Independent schedule analysis]
	<p>Sensitivity Analysis: Rank risks by the magnitude of their effect on total project cost or duration, i.e., how much the project cost or duration changes when risk occurs. May be done in advance of, or in conjunction with, Monte Carlo analysis</p>
	<p>Use Monte Carlo simulation analysis methods for combining risk and base costs or schedule durations</p>
	<p>Review analysis results with expert panel/workshop participants and project owner management.</p>
	<p>Products: <i>Sensitivity analysis; Analysis Results in financial terms (risk plus base costs and/or durations; probabilistic estimates of total project cost and/or duration); Risk Analysis report Assessment Report (summary and findings of Prepare, Identify, Assess, Analyze)</i></p>

Broadly, these processes:

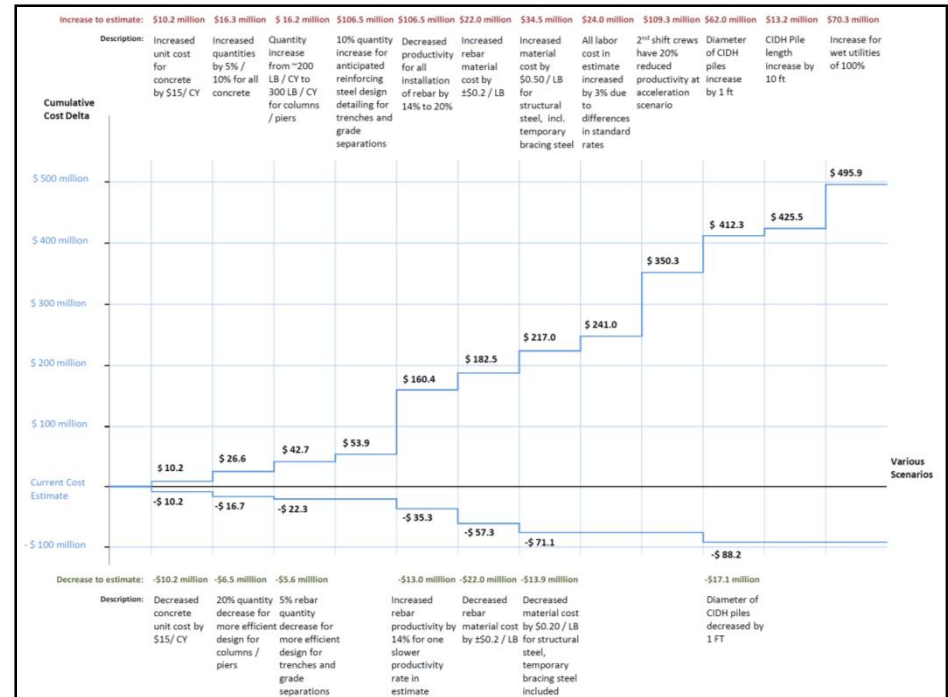
- Provide a measure of overall cost, schedule and revenue risk exposure,
- Identify prime drivers of cost overruns, or schedule delays,
- Establish levels of confidence for particular cost and schedule outcomes,
- Inform follow-on management efforts including prioritization, allocation and contingency recommendations.

The objective is to prevent and assist other Program Management efforts to prevent:

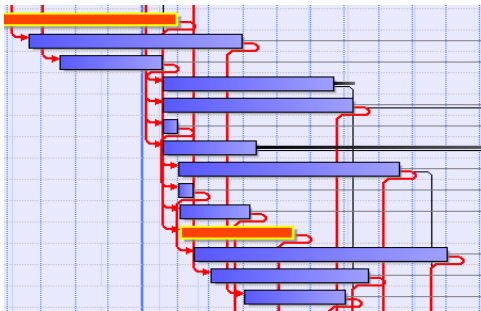
- Cost overruns
- Schedule overruns
- Inadequate or misallocated contingency
- Contingency being expended faster than project can with support

Sensitivity/Scenario Analysis

- ▶ A shorter or longer economic life
- ▶ The volume, mix, or pattern of workload
- ▶ Potential requirements changes
- ▶ Configuration changes in hardware, software, or facilities
- ▶ Alternative assumptions about program operations, fielding strategy, inflation rate, technology heritage savings, and development time
- ▶ Higher or lower learning curves
- ▶ Changes in performance characteristics
- ▶ Testing requirements
- ▶ Acquisition strategy, whether multiyear procurement, dual sourcing, or the like
- ▶ Labor rates
- ▶ Growth in software size or amount of software reuse
- ▶ Down-scoping the program

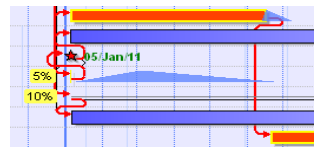
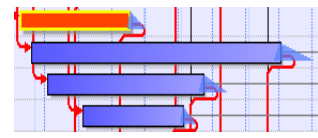


Monte Carlo Analysis: From Deterministic to Probabilistic

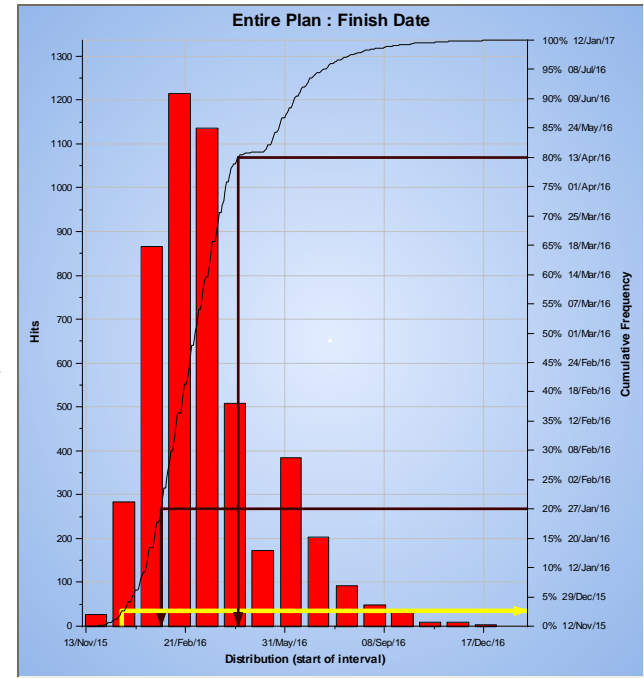


Deterministic
Schedule: *single time,*
single cost, certain events

Time and Cost
ranges for tasks

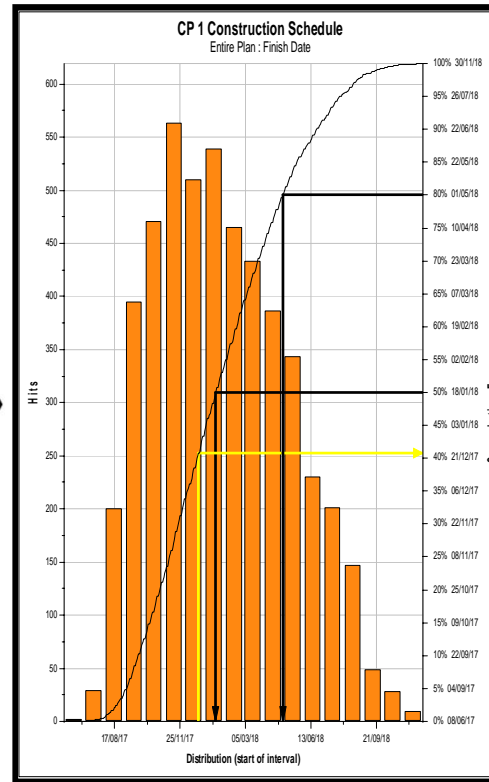
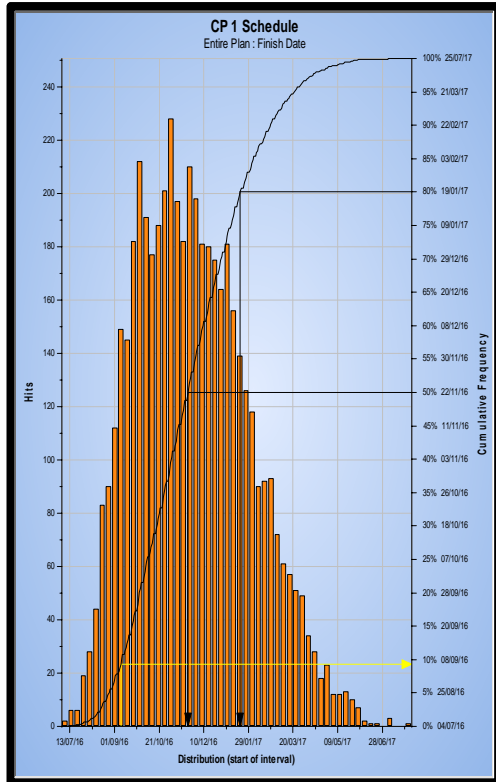


Uncertain events
with uncertain
impacts



Incorporated Risk and
Uncertainty

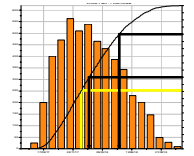
Quantitative Schedule Risk Analysis in Practice



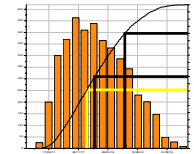
I. Construction Duration Analysis

II. Refinement and Incorporation of ROW and Environmental process

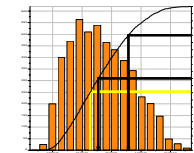
Scenario 1



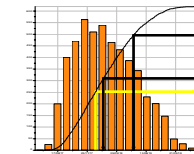
Scenario 2



Scenario 3



Scenario 4

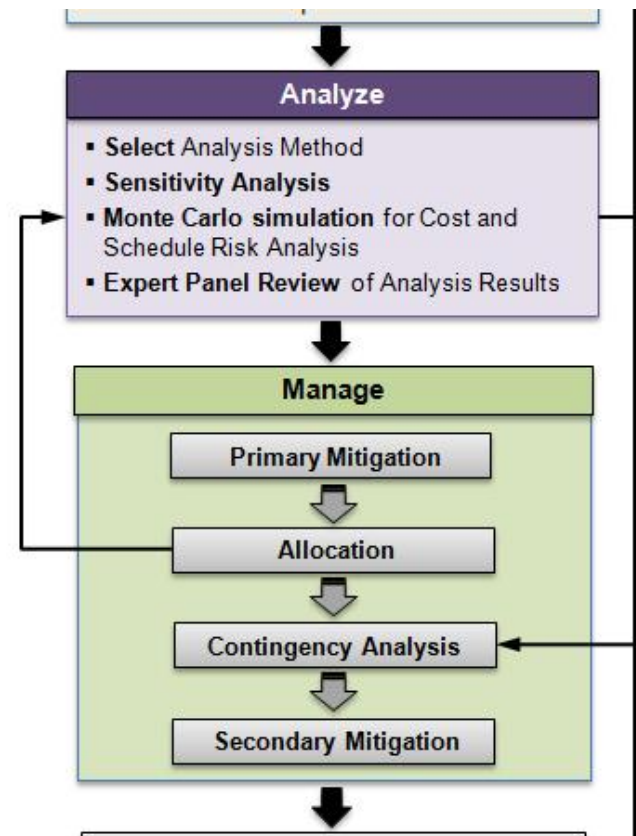


III. Scenario Analysis

Management

FOUR BASIC PROCESSES OR TOOLS:

- **Primary Mitigation:** those actions that the program will undertake to avoid or otherwise diminish the probability of a particular risk occurring and/or the impact if it does
- **Allocation:** Carefully prepared contracts that equitably and cost- effectively allocate these risks between the Authority and the prospective contractor.
- **Contingency:** typically the most visible, quantifiable manifestation of effective risk mgmt is the provision of adequate cost and schedule contingency
- **Secondary Mitigations:** pre-planned, potential scope or process changes that may be triggered when risk events occur that require reduction of contingencies below minimum levels.



Management: Primary Mitigations

'BOTTOMS UP' RISK MANAGEMENT – SPECIFIC actions designed to limit or eliminate the impact of SPECIFIC risks

COMPRISED OF THE FOLLOWING:

- ▶ *Assigning a named individual within a party who assumes an overall responsibility for the management of the risk* -- The risk owner takes the lead in identifying options to reduce the probability or impacts of the assigned risk.
- ▶ *Developing various options for potential reduction in the threat (or enhancement of the opportunity) and cost of implementing the option* -- The risk owner will involve subject matter experts and explore all options.
- ▶ *Selecting the best option for managing the risk* -- After developing various risk response options, the risk owner will, with help from subject matter experts, select the best possible option for the program. This selection process will take into account the cost of the responses, any impact on the project objectives, uncertainty of outcomes and the possible secondary and residual risks.
- ▶ *Assigning actions to execute the selected risk response plan* -- The risk owner will take lead in managing the selected risk response plan and may assign specific actions to other individuals who he or she believes are in the best position to implement them; regardless of any delegation, the risk owner maintains overall responsibility.

Management: Allocation

FOUR FUNDAMENTAL TENETS:

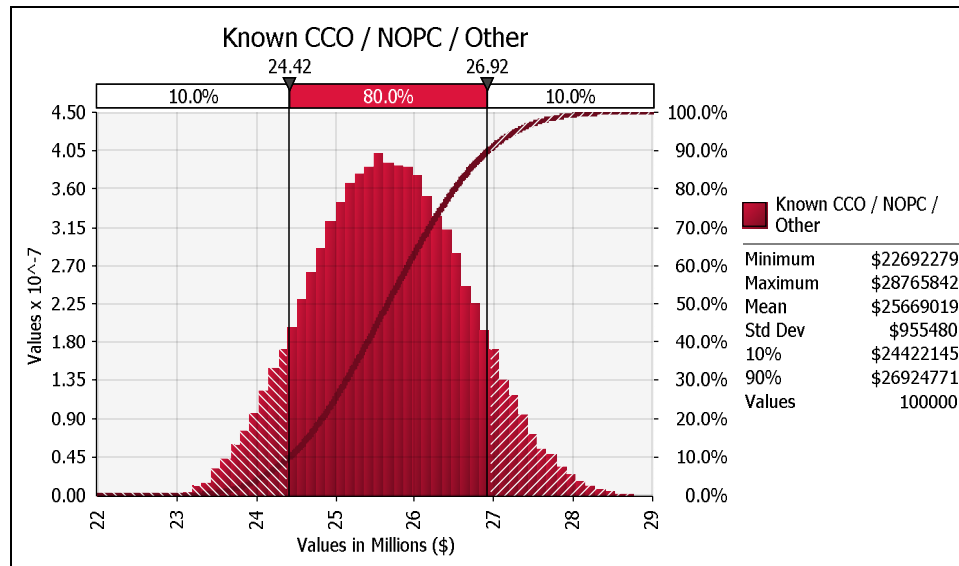
1. Allocate risks to the party best able manage them.
2. Allocate the risk in alignment with project objectives. Project objectives directly determine optimum risk allocation strategies, or when project risk allocation is justified in deviating from traditional industry standards.
3. Share risk when appropriate to accomplish project goals.
4. Ultimately seek to allocate risks to promote alignment with (future) customer-oriented performance goals and expectations.

RISK	Design-Build		
	Owner	Shared	Design Builder
Construction			
DBE compliance			
Safety			
Construction Quality/Workmanship			
Schedule			
Materials Quality			
Materials documentation			
Material availability			
Initial performance requirements of QC/QA Plan			
Final Construction/Materials QC/QA Plan			
Construction/Materials QA			
Construction QC			
Construction QA Oversight			
Construction IA testing/inspection			
Construction Staking			
Erosion Control			
Spill Prevention			
Accidents within work zone			
Damage within work zone			
Third Party Damages			
Operations and Maintenance During Construction			
Maintenance under Construction - new features			
Maintenance under Construction - exist. features			
Maintenance of Traffic			
WSP Callbacks - on site traffic control assistance			
Damage to Utilities under Construction			
Falsework			
Shop Drawings			
Equipment failure/breakdown			
Work Methods			
Early Construction / At Risk Construction			
Community Relations			
Performance of defined mitigation measures			
Warranty			
Force Majeure / Acts of God			
Strikes/Labor Disputes			
Tornado/Earthquake			
Epidemic, terrorism, rebellion, war, riot, sabotage			
Archaeological, paleontological discovery			
Suspension of any environmental approval			
Changes in Law			
Lawsuit against project			
Storm/Flooding			
Fire or other physical damage			
Differing Site Conditions/Changed Conditions			
Changed Conditions			
Differing Site Conditions			
Completion and Warranty			
Establishment/definition of any risk pool			
Long term ownership / Final Responsibility			
Insurance			

Management: Contingency

WHY A RISK BASED APPROACH TO CONTINGENCY DETERMINATION?

Provides information about the level of confidence (probability of sufficiency of contingency) that such assigned contingency provides and what, specifically, that contingency may be used for.



Examples of trends that might adversely affect contingency drawdown include:

- Persistent schedule delays
- An inordinate number of contract change orders
- Market conditions that are known to increase contract costs such as limited number of bidders, increasing fuel and material prices, etc.
- Interface issues between two or more contracts

Management: Secondary Mitigation Planning

- ▶ The CHSRP will actively conduct primary risk mitigation, as described previously in this Risk Management Plan, to reduce the overall level of risk. This will improve the CHSRP's chances of having sufficient contingency available for unanticipated costs or schedule delays.
- ▶ There will, however, be risks that cannot or have not been anticipated or cannot, practically, be avoided, mitigated or allocated in a cost-effective manner.
- ▶ For situations or specific risks where available contingency will not be enough to protect CHSRP against significant adverse impacts to its cost, schedule or other objectives, the Program will develop secondary mitigation plans to provide the means to replace contingency expended beyond planned amounts for any period of time.

Progress to date

- ▶ Program Risk Register: The Authority maintains an extensive risk register and has done so for approximately 3 yrs. The risk register is regularly updated based on meetings with Program personnel as well as quarterly risk workshops with the regional teams.
- ▶ Risk Management System (RMS): The Authority has developed and implemented a web-based RMS which is currently in 'beta' testing and being used to collect and monitor risk information prior to a full roll-out to the Program team.
- ▶ Revised Risk Management Plan: originally developed in 2010, updated in 2012 and recently revised to better address SB 1029 requirements and further define and systematize our process for determining the Program's financial risk exposure.
- ▶ Quantitative Schedule Risk Analysis employing Monte Carlo simulations: undertaken and completed to determine a 'reasonable', risk adjusted duration for construction on Contract Package 1 and identify specific, high-risk areas (as measured by their probability of exceeding the planned construction duration).
- ▶ Cost sensitivity analysis for Construction Package 1: originally developed in response to a GAO request, going forward it will now be done for all construction packages and has been incorporated into our process as laid out in the revised Risk Management Plan referenced above.
- ▶ O & M quantitative risk analysis: a quantitative analysis of the O&M Cost methodology, model and results was recently completed. The risk analysis employed both a Top down and Bottom-up approaches to 'stress test' the O&M cost model, assess the adequacy of the provided contingency and determine the overall probability, or confidence level, of different cost outcomes.

Upcoming Activities and Deliverables

- ▶ CP 1 Contingency analysis
- ▶ Construction Package 2 and 3 analysis with the following deliverables:
 - Basis documents for both cost estimate and schedule, following template included in revised RMP
 - Revised and quantified risk identification and assessment specific to CP 2/3 and the proposed alignment
 - Sensitivity Analysis
 - Preliminary Monte Carlo analysis (pre-allocation)
 - Risk Allocation Matrix
 - Post-allocation Monte Carlo analysis and contingency recommendations
 - Post-allocation mitigation plan
- ▶ Reports to the legislature per SB 1029 requirements
- ▶ Internal quarterly updates on risk management
- ▶ Risk Management System (RMS) reconciliation to ensure the RMS fully supports updated guidance in revised RMP
- ▶ Preliminary Ridership and Revenue risk analysis
- ▶ (As necessary) Updates to O&M Cost risk analysis

Conclusion

The CHSTP's process for managing risks has been revised to further refine our implementation and enhance our risk management 'tool-set.' While the overall process of identifying, assessing, analyzing and managing risks is the same, we have significantly augmented the plan to more directly tie our risk management process to the underlying scope, cost and schedule basis as well as follow-on Program Management efforts. The most significant revision/additions are to our process for quantitatively assessing, analyzing and managing our financial risk exposure. This revised Risk Management Plan now delineates a specific process and workflow by which risk will be:

- Quantified in financial terms,
- Related to the underlying scope, cost and schedule,
- Analyzed and
- Managed through primary mitigations, contractual allocation, contingency and, if necessary, secondary mitigations

The overarching purpose of these and other revisions is to further systematize and motivate the identification and management of risks and enable the CHSRP as a whole to better meet and overcome the challenges which it will inevitably confront.