

California High-Speed Train Project



TECHNICAL MEMORANDUM

RISK REGISTER DEVELOPMENT PROTOCOL for Regional and Core Systems Teams TM 0.6

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1.0 PROGRAMMATIC RISK MANAGEMENT AND RISK REGISTER DEVELOPMENT

The purpose of this memorandum is to define objectives and protocols for the development of risk registers by regional teams for the implementation of a consolidated risk management process consistent with the scope and magnitude of the California High Speed Train Project (CHSTP). It is intended to provide more specific guidance to the regional teams in development of their individual risk registers and, more generally, carrying out risk management efforts in line with the principles and methodology provided in the program's Risk Management Plan. This Risk Register Protocol (RRP) memorandum is considered to be living document and will be periodically revisited and modified as necessary.

Risk Management encompasses all aspects of the identification, assessment, analysis and management of risk (both threats and opportunities). We have a broad definition of what is meant by risk. A "risk" is an uncertain future event – internal or external – with the potential to impact the project objectives. "Risk Management" is an explicit, systematic process to identify, assess and manage these uncertain events, so as to maximize the chances of achieving the program (and regional project) objectives. The protocols described in this memorandum support risk management by systematizing the efforts to identify risks and develop and communicate action plans, as embodied by the risk register. As such, the risk management process as a whole helps us understand and manage the relationships between the business environment, our strategic objectives, the risk to achieving these objectives, and our actual performance.

The primary risk management deliverable for the regional teams is the risk register. The risk register will contain all individually identified risks to the team's budget or schedule, including, as necessary, system safety risks with the potential to impact cost and/or schedule. It will be developed in conjunction with the cost and schedule estimates and together, these should provide a complete picture of not only what is intended with regards to cost and schedule, but challenges (and opportunities) with the potential to affect these plans.

PMT Risk Analysts will integrate the information developed by the Regional teams in the risk registers with cost and schedule estimates and risks identified by other elements of the program team to develop a complete picture of the challenges facing the project and inform contingency levels. In addition, this process will established levels of confidence for particular cost and schedule outcomes to better understand and communicate the potential impacts of 'scope-creep' and other issues to the Authority.

The risk registers themselves serve two basic functions:

- 1. It is an action plan – a complete risk register is not limited to an identification or assessment of risks, it must specify what is being done by the project team to overcome these challenges, who is responsible for doing it and when it will be done.**
- 2. It is a communication tool – it provides a concise summary of the challenges currently facing the project together with the what, who and when of their management for other team members and regions as well as management and the Authority.**

All processes and protocols presented in this memorandum are intended to serve one or both of the above functions and all risk register development efforts should be carried out with them in mind.

Figure 1 summarizes the risk register development process, principles and objectives intended to support these two core functions. They are discussed in more detail in the following sections.

Risk Register Development Process

Principles

- **Ownership** - each group, function, and/or team will comply with and embed Project requirements, process and procedures for risk management; risks will be held by individuals at the lowest organizational level for which management is feasible.
- **Business alignment** – all key decisions supported by explicit consideration of risk with balanced consideration of safety, regulatory and commercial factors.
- **Action oriented** – risks and opportunities linked to response plans with timely tracking of actions.
- **Review** – risk management processes will be documented and included in the management system.
- **Reporting** – on risk and the effectiveness of associated key controls and risk responses, following normal reporting lines through the Program.

Objectives

- **Link risk and returns** – should enhance the Project’s capacity to anticipate events, assess risks and set risk tolerances consistent with achieving objectives;
- **Rationalize resources** – more effectively deploy resources by identifying key drivers of Development and Delivery, thereby reducing overall capital requirements and improving capital allocations;
- **Exploit opportunities** – aid the identification, and ability to take advantage of, positive events quickly and efficiently;
- **Reduce surprises and losses** – identify potential adverse events, assess risks and establish responses, thereby reducing surprises and related costs, schedule delays or losses;
- **Report with greater confidence** – internal and external information that is reliable, timely and relevant;
- **Satisfy legal and regulatory requirements** – ensure compliance with legal and regulatory requirements and identify risks of non-compliance.

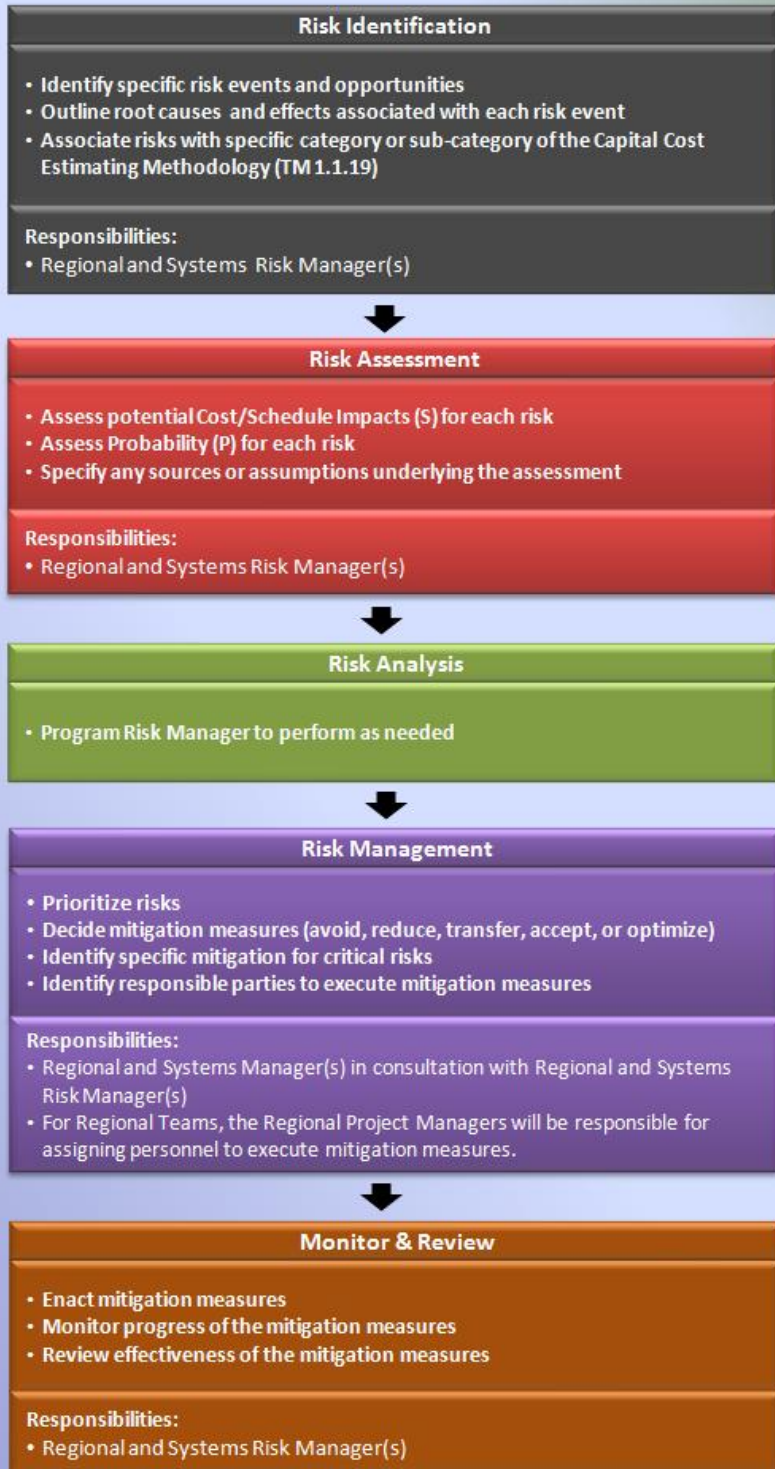


Figure 1 Risk register development principles, objectives and process summary

2.0 Personnel Requirements and Primary Risk Management Responsibilities

As a member of their staff reporting directly to the regional project manager, each regional team is expected to have a qualified, experienced risk manager to oversee implementation and execution of the protocols in this document. The principal personnel involved with risk management on CHSTP are given below, together with their primary responsibilities.

PROGRAM MANAGEMENT TEAM

Program Risk Manager: Establish and oversee risk analysis methodologies and procedures; integrate and report on information from Risk Analyst, Regional Risk Managers and other program elements (e.g. Railroad Operations, EMT, Environmental, Staging / Procurement).

Risk Analyst: responsible for integrating information received from regional teams (risk register, cost and schedule estimates) to inform cost and schedule contingencies and ensure consistent application of cost and schedule standards and procedures across regions and sub-systems as they relate to the risk management process

EMT Risk Manager: develop risk registers for Rolling Stock, Train Control, Traction Power/OCS, Communications and Maintenance (these registers are strictly limited to risks with potential cost or schedule impacts – System Safety aspects are a separate effort) and establish appropriate ranges for cost and duration ranges that reflect residual uncertainty, i.e. variability exclusive of individually identified risks.

REGIONAL CONSULTANT TEAMS

Regional Risk Manager(s): develop information required for risk registers, facilitating the identification and assessment of individual risks together with appropriate mitigations following policies and procedures; one/region, eight total

3.0 Risk Register Development Process

While there will be a number of other potential impact areas specified for assessment (e.g. environmental, construction safety, legal/community relations), these can, and generally will, be translated and specified in terms of potential cost and/or schedule impacts to the project. For this reason and for purposes of brevity, the discussion that follows will only reference cost and schedule as potential impact areas. This should not be understood to mean that project considerations with regards to risk will be limited solely to these impact areas.

Assessments of cost and schedule risks will ultimately be specified in quantitative or semi-quantitative (numeric ranges) terms. In addition to allowing objective comparisons of risk exposure across regions and systems that qualitative specifications such as 'high' or 'low' do not, quantitative specifications allow tools such as Monte Carlo methods to be employed for schedule and cost risk analysis. Specifically, it allows objective comparisons between individual risks for prioritization, development of a risk exposure profiles and direct comparison of this risk exposure to available contingency.

When system safety risks have potential cost or schedule implications the *mitigations* to such system safety risks (or hazards), where not accounted for in the base estimate, will be carried as risks on the appropriate risk registers until a decision is made by system safety personnel if or what mitigations will require changes to the design on which the current estimate and schedule is based. At such time, the delivery risk engendered by the possible mitigation to the system safety risk will transition from the risk registers to the cost and/or schedule estimate. More discussion is included on this situation in the following sections.

Risk register development proceeds through the following stages, with the Identification, Assessment and Management elements forming the core of the Risk Register:

- Project Definition
- **Identification**
- **Assessment**
- Analysis
- **Management**
- Monitor and Review

As the project moves forward, risks are periodically revisited and reassessed to reflect the current status of the program. Regional teams are expected to maintain their risk registers and these registers should reflect the current status of the Team's risk management efforts.

3.1 RISK MANAGEMENT PRINCIPLES

As stated earlier, the risk management process as a whole helps us understand and manage the relationships between the business environment, our strategic objectives, the risk to achieving these objectives, and our actual performance. It is founded on the following general principles:

1. *Ownership* - each group, function, and/or team will comply with and embed Project requirements, process and procedures for risk management and individual *risks will be held by specific, named, individuals at the lowest organizational level for which management is feasible.*
2. *Business alignment* – all key decisions are to be supported by an explicit consideration of risk with balanced consideration of safety, regulatory and commercial factors.
3. *Action oriented* – risks and opportunities must be linked to response plans with timely tracking of actions.
4. *Review* – risk management processes will be adequately documented and included in the management system.
5. *Reporting* – reporting on risk and the effectiveness of associated key controls and risk responses is an integral part of management information, following normal reporting lines through the Program.

Identifying and regularly re-evaluating the risks facing the project, prioritizing these risks, and implementing appropriate actions requires a clear focus on actions with a close link to planning and performance management. Included is the careful balancing of economic and safety factors. Generally speaking, an effective Risk Management effort should be able to provide answers to the following questions:

- Are our **objectives** at risk?
- What are the **major risks** facing the Project?
- What is our current and future **risk profile**?
- How well are risks **controlled**?
- Are implemented **controls working** as they should?
- Are **corrective measures** implemented as planned?

It is neither feasible nor desirable that Risk Management be the sole responsibility of a single individual or isolated group within the project team. In addition to active participation during the identification, assessment and management stages, each Regional Risk Manager, in conjunction with the Regional Project Manager and Regional Manager, is expected to:

1. Comply with the risk management principles outlined in above.
2. Adopt, or ensure compliance with, the roles and responsibilities specified in this document, as appropriate
3. Specifically report on key risks, risk management efforts and status of all identified risks via a current risk register on a monthly basis, in the prescribed way, using standard terminology and measures

These principles, roles and responsibilities ultimately serve to accomplish the following objectives:

- Link risk and returns – fundamentally, Risk Management should enhance the Project's capacity to anticipate events, assess risks and set risk tolerances consistent with achieving objectives;
- Rationalize resources - Allowing the project to more effectively deploy resources by identifying key drivers of Development and Delivery, thereby reducing overall capital requirements and improving capital allocations;
- Exploit opportunities – aid the identification, and ability to take advantage of, positive events quickly and efficiently;
- Reduce surprises and losses – identify potential adverse events, assess risks and establish responses, thereby reducing surprises and related costs, schedule delays or losses;
- Report with greater confidence - Preparing internal and external information that is reliable, timely and relevant; and
- Satisfy legal and regulatory requirements - Supporting efforts to ensure compliance with legal and regulatory requirements and identify risks of non-compliance.

3.2 DEVELOPMENT PROCESS

Project participants will work on different and/or multiple high-speed train corridors and will be working at varying stages of project development concurrently. Recognizing that the risk management activities require involvement of multiple project participants having different roles and responsibilities on the project, the table below provides a summary view on how risk management responsibilities for the development of the risk register are going to be shared.

Error! Reference source not found. identifies the areas of responsibility for the California High-Speed Rail Authority (Authority), Program Risk Management Team (PRM) and Regional Consultants (RC) at each major step in the Delivery Risk Management processes. These responsibilities are described as Approve (A), Review (R) and Perform (P).

Risk Management Stage		Authority	PRM	RC
1	Identify Risk(s)/Opportunities and keyed to Cost Estimating Methodology	-	R	P
2	Assessment: Potential impacts, probability and statement of assumptions, supporting doc.	-	R	P
3	Analysis	-	P	R
4	Management: identify potential mitigations, assign responsibility for carrying out these mitigations	A	R	P
5	Monitor and Review	-	R	P

Note: A = Approve, R = Review, P = Perform

Figure 2 summarizes the process with areas of risk register development that are primarily the responsibility of the Regional Risk Manager and their team in orange.

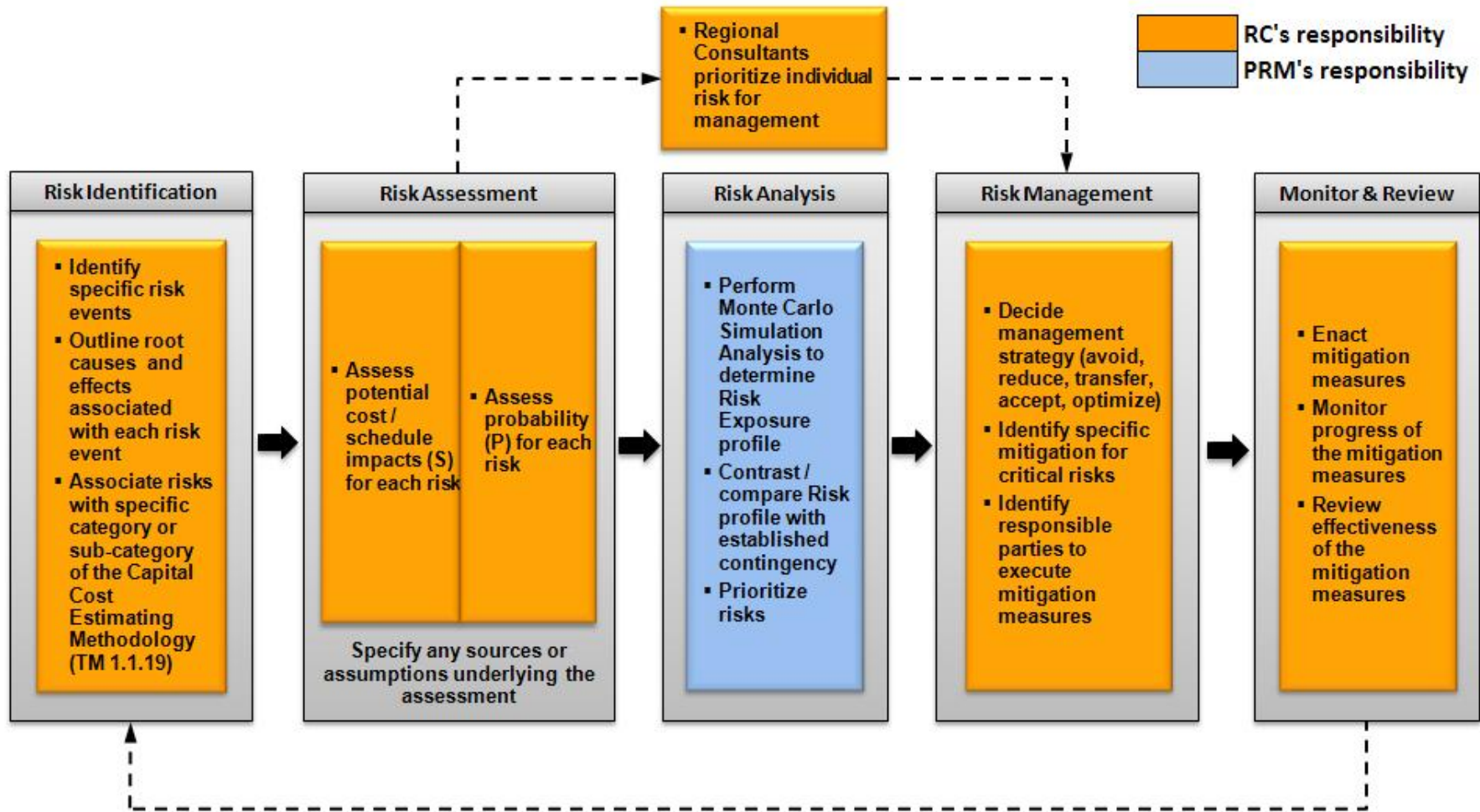


Figure 2 Delivery Risk Management process flowchart showing the five main stages of risk management

3.2.1 IDENTIFICATION

Proper risk identification considers the program's objectives and identifies events or situations that might act against these objectives (risks) or advance these objectives (opportunities). It consists of four elements:

- Description of the risk/opportunity
- Associated cost and/or schedule elements
- Specification of the Cause/Effect relationship

Descriptions and cause/effect relationships will be refined over time. Initially, it will suffice if it is clear what the assumption is to participants and can be generally understood by outside reviewers.

There are two primary goals for this stage:

1. Development of a comprehensive list of assumptions underlying the cost and schedule estimates
2. Inclusion of enough description in the form of the description itself and the cause/effect relationship that the team will be able to move forward with the assessment stage

Specifying a cause/effect relationship serves three purposes:

1. Establishes a clear understanding and definition of the issue under consideration that general risk/opportunity statements do not
2. On the cause side, suggests possible mitigation measures once the management stage is reached
3. On the effect side, serves to tie the identified risk or opportunity to the project's objectives, presaging the impact assessment

Given the risk register development process's reliance on the expertise and judgment of the contributors, it is critical that Risk Managers involve (and motivate) the right people. It is recommended that individuals with the following areas of expertise be involved with the initial risk identification, assessment and management workshop and as required for follow on risk management efforts by the Regional Risk Manager:

- Implementation Planning
- Environmental Planning
- Funding/Approvals
- Project Management
- Engineering Design
- Architectural Design
- Cost Estimating
- Scheduling
- Budgeting/Controls
- Real Estate
- Constructability/Contractor
- Operations

- Other Technical (e.g. Legal, Permitting/Procurement)
- Risk Facilitation

The above are general recommendations – the particulars of a region may not require all areas indicated or may require other, additional areas of expertise. Regional Risk Managers will, however, be expected to submit a record of personnel together with their area of expertise that indicates appropriate personnel with requisite experience were involved in risk identification, assessment and primary mitigation activities. It is understood that the Risk Manager alone will not have the expertise to identify and assess the risks for a program of this size or complexity. Selecting and motivating the right people, especially in the context of risk workshops, will be one of their primary duties.

The PMT will provide personnel to facilitate the initial risk workshop in each region to establish a consistent basis for future efforts by the Regional Risk Managers.

INTEGRATING RISK MANAGEMENT WITH COST AND SCHEDULE ESTIMATING

Risk identification should be done in conjunction with the development and review of cost and schedule estimates. The first stage of identifying risks should be a clear delineation of all assumptions (both positive and negative) that underlie the current estimates and schedules.

Risk Managers will ‘walk’ the cost estimate with the project team, noting any assumptions. The same should be done with the schedule with respect to overall structure of the schedule and the individual activity durations. The project team should identify and note these assumptions, determine the validity of these assumptions and, ultimately, how likely they are to remain valid as the project progresses. Making these assumptions explicit should be the first step in the development of the risk register.

The easiest and *most effective* way to accomplish the above is to make the cataloguing of assumptions part of the development process for the cost and schedule estimates, beginning with the 15% design level. Regional Risk Managers should also review hazards identified as part of System Safety efforts with the project team. In particular, any proposed mitigations to these hazards with cost or schedule implications should be checked against the cost and schedule estimate to see if they have been accounted for. If not, the *mitigation* needs to be included in the risk register as a potential change to the cost/schedule. For such risks, the potential impact is the estimated cost of the mitigation and the likelihood is the probability that this mitigation will be enacted. For these risks, Risk Managers will work with their teams to develop likely cost/schedule impacts with System Safety personnel providing guidance for the probability assessment. This issue will be discussed further in the following sections.

Regional Risk Managers are expected to be fully aware of all assumptions embedded in the cost and schedule estimates and what they indicate with regards to what is, and more importantly, what is not, represented by the cost and schedule estimates.

Once the above basis has been established, Regional Risk Managers can move to more ‘free-form’ identification with a review of hazard checklists (one example is provided in Appendix C – General Hazard Checklist), plans and profiles and historic problem areas on other similar projects (as given in the RMP, including reference works cited there).

When these reviews point up risks not associated with the previously identified assumptions, RCS Risk Managers should work with the project team to develop descriptions and cause/effect relationship and associate the risk with the appropriate cost or schedule element.

3.2.2 ASSESSMENT

Based on the risk and its potential impact on the project's objectives, each risk will be assessed for potential impact and probability in semi-quantitative (numeric ranges) or quantitative (specific dollar amount or duration) terms. A risk assessment scoring guide showing the quantitative likelihood and impact ranges is provided in the Appendix B – Risk Scoring Guide, and should be used when assessing both the impact and probability of risks. Any support for this assessment (e.g. contract terms, relevant past projects, formulas) should be recorded at the time the assessment is made. As with the rest of the stages, assessments will be periodically revisited and refined.

Impacts should be assessed in terms of identified project objectives and a single risk may have numerous potential impacts. While there are a number of other potential impact areas specified for assessment (e.g. environmental, construction safety, legal/community relations), these can, and generally will, be translated and specified in terms of potential cost and/or schedule impacts to the project. This should not be understood to mean that project is only concerned with risks that explicitly impact cost or schedule.

The goal for assessment is two-fold:

1. Develop broadly accurate (as opposed to precise) estimates of potential impact and probability
2. Ensure *relative* accuracy with a consistent approach

With regards to the second point, an inconsistent approach that inaccurately elevates the importance of some risks and lowers others will distort management priorities and hamper risk management efforts..

The assessment has two broad deliverables:

1. The assessment itself
2. Assumptions or supporting information underlying these assessments.

The assessment is composed of two parts:

1. Potential impact of the risk (quantified as cost or duration ranges)
2. Probability that the event or situation will occur.

Risk Managers should make a clear delineation between impact assessment and probability assessment and proceed in the order indicated above. If these two steps are not clearly separated, especially in a workshop format, there is a tendency for participants to conflate the two. For example, risks that the assessors feel are low probability may end up with lower impact assessments than would otherwise be justified. As the assessment motivates the prioritization for management, risks that in actuality have the potential for high or even catastrophic impacts on budget or schedule may not receive the management attention that they should. Risk Managers should explicitly ask participants

‘Assume the risk event or situation happens, what would the impact be?’

Only once some consensus (in the case of a group) impact assessment has been established should the Risk Manager begin considering the probability assessment. Once the probability assessment is made, the risk is considered fully ‘quantified’ and the risk exposure for the project due to the individual risk is given by

$$\text{Risk Exposure} = \text{Impact} \times \text{Probability}$$

An even more common problem than the conflation of probability and impact is the tendency of participants to confuse the manageability of a risk with the risk exposure it represents. Significant problems arise from mixing assessment and management discussions in the context of Risk Management. Potentially severe risks for which participants can think of a number of solutions are inevitably downgraded during assessment; otherwise minor risks for which none of the participants can readily think of solutions end up with higher exposure values than are otherwise justified.

Risk Managers must draw a bright line between assessment and management discussions on the first identification, assessment, (prioritization), and management cycle. It is likely that they will have to actively delay management discussions until the assessment is complete. They should also alert participants to the problem so that they can defend against this bias in their assessments.

RISK SCORING

As indicated below, the risk assessment scoring employs relatively broad ranges for both potential impact and probability.

	1	2	3	4	5
Likelihood	Very Unlikely (1 - 10%)	Unlikely (11 - 35%)	50/50 chance (36 - 64%)	Likely (65 - 89%)	Highly Likely/ Near certainty (90 - 99%)
Cost Impact (\$)	Tens of Thousands (\$10,000 to \$100,000)	Hundreds of Thousands (\$100,000 to \$1 Mil)	Millions (\$1 to \$10 Mil)	Tens of Millions (\$10 to \$100 Mil)	Hundreds of Millions (>\$100 Mil)
Schedule Impact (workdays)	Days	Weeks	1-3 Months	3-12 Months	Year or longer

Where more specificity is justified, either on the initial assessment or subsequent reviews, the assessment team can supply their own, narrower range. Additionally, if a particular value between the lower and upper bounds of the assessment judged more likely than others it can be designated as 'Most Likely'.

Narrower probability ranges than those above can also be used. Given the nature of delivery risks, however, it is generally less likely that narrower ranges are justified.

When assessing a risk that may impact multiple points or segments, the description and cause/effect relationship can help determine whether it is more appropriate to break the risk up into multiple instances, each affecting a specific point or segment (such may be the case with ROW risks where there are issues specific to a particular parcel) or keep it as a single risk with an impact assessment that represents the total potential cost of the risk. In either case, the decision can be reviewed once specific mitigations are identified. If the same mitigation action is likely to affect the risk for all the individual instances equally, consider treating it as a single large risk. If different mitigations will need to be applied at different points on the alignment, it is recommended that the risk be broken up into individual instances.

An exception to the relatively wide probability ranges given above commonly occurs as the project progresses: the case when the underlying risk event or situation has occurred but the cost/schedule impact on the project is still uncertain. The example mentioned earlier – when the delivery risk is mitigation to a hazard identified as part of System Safety efforts – is a common case. Once (if) it is determined that the mitigation will be incorporated into the design, the probability is designated as 100% with the risk stemming from the uncertainty surrounding how this change will impact the project. As the design for this element develops, the impact range can be progressively narrowed until it reaches a stage where it is appropriate to transition it out of the risk register and incorporate it into the base cost or schedule.

Example:

Description: In response to system safety efforts regarding intrusion protection, there is the potential that barrier walls will be required at locations x, y, and z (more locations possible). These barrier walls are not part of the current design or cost estimate.

Cause/Effect: mitigation to intrusion hazard requires barrier walls / barrier walls of length *l* (each) added at locations x, y, z

Assessment: \$10's of Millions, likelihood: likely (65 – 90%)

If the barrier wall was subsequently required, the probability would be changed to 100% and the impact narrowed as locations were solidified and wall designs developed in anticipation of this risk's removal from the register and incorporation in the cost and schedule estimates as an additional element.

3.2.3 ANALYSIS

For Regional Risk Managers and their project teams, the Analysis stage will consist of the prioritization of risks in anticipation of the Management stage of the process, as indicated in Figure 2. This will be relatively straight forward for cost risks, as the risks can, preliminarily, be ranked by mean exposure. For schedule risks the situation may be more complex as the potential exposure is not only due to the absolute value of its assessment, but also where it falls in the schedule. Specifically, how much float the associated activity has in relation to the duration of the potential delay. The Program Risk Manager will employ Monte Carlo Simulations for analysis in such situations as and when it is needed in support of Regional Teams' efforts.

The prioritization of risks that result from this analysis is intended to inform, not define, the prioritization developed by the regional teams in consultation with the PRM and Authority. It is not the exclusive means by which this prioritization is determined. In practice, this analysis will take place concurrently with the Regional Team's efforts and, generally speaking, the Regional Team's risk management efforts will move from Assessment to Management in accordance with their own preliminary prioritization of individual risks. Prioritization is discussed further in the following section.

3.2.4 MANAGEMENT

The discussion in this section refers specifically to activities and deliverables of the management stage of the Risk Management Process as given in Figure 2, not general risk management processes and deliverables discussed earlier.

Management stage tasks:

1. Determine what management strategy is appropriate for the given risk:
 - Avoid (eliminate the probability of occurrence with, e.g. design changes),
 - Reduce (limit the potential impact and/or probability),
 - Transfer (to a third-party),
 - Accept, *or*
 - Optimize (in the case of opportunities);

NOTE: any decision to 'accept' a risk, i.e. not develop mitigations for, or actively manage, the risk, must be made in consultation with the PMT

2. Identify actions (if any) that can be taken by the *Regional Team members* to reduce or eliminate the potential impacts, likelihood of occurrence or both
3. Specify a 'due-date' for all actions identified in (2.)
4. Inform the regional Project Manager and Program Risk Manager of any risks for which management responsibility is more properly the responsibility of the PMT or Authority; specifically, when the proposed mitigation(s) require action by persons outside the immediate regional or system team.
5. Identify individual team members that will take responsibility for carrying out any identified risk mitigations – with reference to the above strategies, if risk/opportunity is to be:
 - a. Avoided, reduced or optimized a specific team member with the ability, both in terms of expertise and authority, to effectively manage the risk (or capture the opportunity) within the project team must be named as the responsible party;
 - b. Transferred, this party must be named;
 - c. Accepted, the Regional Project Manager assumes responsibility for monitoring this risk and periodically reassessing the advisability of this management strategy

While the previous risk register development work in identification and assessment can be largely driven by the Regional Risk Managers, management decisions made during this stage are largely made by Regional Managers and Regional Project Managers as prioritization, choice of management strategy, and action assignments involve core management responsibilities. The principal duties for Regional Risk Managers during this stage are:

- Assist Regional and Project Managers in development of mitigations, and more generally by facilitating the above tasks
- Oversee progress on action items, ensuring action items are completed on time and acting as a resource for the rest of the project team

The risk register should stand as a concise action plan. As such, it should provide the what, who and when of the project's risk response and should provide answers to the following:

- What are we going to do to limit the project's risk exposure due to the identified risks?
- Who is going to do it?
- When is it going to be done?

In determining the management prioritization, Regional and Regional Consultant Managers should consider the following:

- 'Manageability' – Have mitigations to the risk been identified? How effective are these mitigations likely to be?
- Cost/Benefit – How much will the proposed mitigations cost and how does this cost compare with the potential cost of the risk event/situation should it occur?
- Intangibles – how might the risk event/situation affect the project (or program as a whole) if it occurred in ways less tangible than additional cost or delay (e.g. reputation or community relations)?
- Worst-Case Scenario (upper bound considerations) – certain risks, due to low probability and/or low ML and lower bound assessments, may have relatively low mean values despite a potentially catastrophic impact should the risk occur (as indicated by the upper bound of the impact assessment); these types of risks may warrant more management attention and resources than other risks with similar or even slightly higher mean risk exposure values.

In conjunction with this prioritization or following it, Regional and Regional Project Managers can determine an appropriate strategy. Decisions regarding what constitutes 'appropriate' may be informed by subsequent development of mitigations.

Per task 4, above, responsibility for the management of individual risks will be assigned to individuals in the best position to manage the risk; once the project team has decided that a particular risk should be actively managed and a general management approach is determined (limiting the probability of occurrence, the severity of the impact, or both):

1. An individual with necessary expertise and authority will be assigned management responsibility for the particular risk;
2. Individual action items will be determined and assigned depending on the size and complexity of the risk. These actions may be assigned to the same person who has overall management responsibility or, for larger issues, may take the form of an ad-hoc team of individuals in the best position to carry out mitigating actions; tasks should be well-defined, assigned to named individuals and have a due date.

All risks must either be assigned to a specific individual on regional team for management or, if no one on the regional team is in a position to properly manage the risk, brought to the attention of the Program Risk Manager for assignment.

3.2.5 MONITOR AND REVIEW

The process as outlined in the previous steps is intended to be continuous and ongoing for the life of the project. Regional Managers, Regional Consultant Project Managers and Risk Managers are expected to regularly monitor and review their risk management efforts to ensure compliance and maintain current records of their risk management efforts. In particular:

- Individual Risks (and opportunities) should be regularly reviewed to ensure that they accurately describe a current threat to project objectives, that their assessments reflect the best estimate of potential impacts and probability and that management strategy and mitigations are well-founded
- Individual team members with management responsibility for one or more risks should monitor and be able to report on the above for their particular risks to their Regional Risk Manager
- The Regional Manager, Regional Consultant Project Manager and Risk Manager should be able to identify and report on the key risks facing them at the current time
- The status of individual mitigations should be regularly updated to reflect the current

status of these efforts and team member responsibilities

It is suggested that these reviews and updates of the register itself proceed on an incremental (continuous) basis with individual team members or functional groups – groups larger than five or six are not conducive to detailing individual risks, nor is it generally a productive use of most participants' time. Additionally, scheduling all the individual team members who may contribute to any single part of the process at one time generally precludes regular reviews and leads to start-stop-start-stop risk management efforts and meetings largely given over to recalling what was discussed and decided at the previous meeting.

It is the responsibility of the Regional Risk Manager to motivate and schedule these small-scale reviews and update sessions with the individual or functional groups. It is the responsibility of individual team members or group leads to alert the Regional Risk Manager of any changes in previously identified risks, or new risks that have been identified in the course of their work, in a timely manner.

The entire team should review the current status as a group as the Regional Project Manager sees fit, though it is suggested that these meetings do not take place less often than once a month. These larger sessions are not intended for identification or reassessment of individual risks but instead as updates for the team as a whole on the big challenges facing the project, what is being done about them (or, in the absence of identified mitigations, discussion about what can be done) and general discussion about any issues on the horizon. The Regional Risk Manager can follow-up with individuals or smaller groups after the meeting to further develop and refine any issues raised at the general review meeting.

3.3 DOCUMENTATION AND REPORTING

Effective risk reporting allows management to quickly grasp the key concerns and recent changes, identify who has prime responsibilities for actions as well as the status of priority actions. The information provided needs to address the following questions:

- *“What are our key risks/showstoppers and what is being done to manage them?”*
- *“Which key risks have ineffective responses or outstanding improvement actions?”*
- *“What has changed since the last period?”*
- *“What could prevent us delivering on the strategic program objectives and what is being done to mitigate these issues?”*
- *“What is the reason for current performance gaps and do the risks and opportunities identified previously explain this? If not, what must be done to improve our risk and opportunity management and our forecasting?”*

Regional teams will answer these questions with respect to both their own specific objectives and the larger program objectives and be diligent about alerting other organizational elements about any potential issue that may impact these other elements or the objectives of the program as a whole.

In addition to the risk register itself and information sufficient to answer the above questions, Regional Risk Managers should maintain the following current records/logs:

- A complete record of any information used as a basis for conclusions contained in the report, either as reference or full item
- Explicit record of assumptions underlying all significant risks/hazards contained in the risk register with respect to the identification, impact assessment or management
- Meeting log identifying subject matter, location, duration, date, participants and experience

The Program Risk Manager will develop a common report format in consultation with Regional Risk Managers to facilitate the above and ensure consistency across regions and systems. This report template will be provided to Regional Risk Managers in advance of their first report.

APPENDIX A – RISK REGISTER TEMPLATE

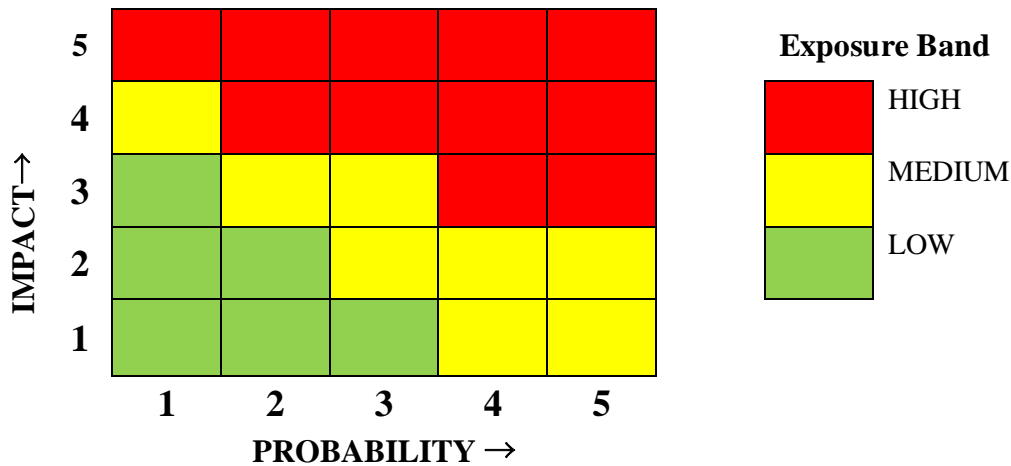
Risk Events Worksheet											
IDENTIFICATION Include enough detail for other team members to be able to form their own assessment of this risk and its significance to the project						ASSESSMENT			Comments/ Assumptions / References underlying assessment	MANAGEMENT Actions that may be taken by the regional project team to limit pessimistic (maximum) outcomes and/or make optimistic (minimums) more likely	
Region, Sub-system or Prgrammatic(P) If Reional issue, CHSTP Milepost reference if appropriate	Risk I.D. Number [FTA Code - Risk #] e.g. 10.04 - 02 for the second risk identified in FTA cost code 10.04	Short Title	Cause	Most Likely Effect on project objectives	Categorization by Mitigation Timing 1. Requirements Risk [R] 2. Design Risk [D] 3. Market Risk [M] 4. Construction Risk [C] a. Early Construction Risk [C-E] b. Mid-Range Construction Risk [C-M]. c. Start-Up / Substantial Completion Risk [C-L]	Cost Impact/Severity Estimated Range (\$) <i>Assume the event happens, what is the Most Likely impact?</i> 1. 10's of Thousands (\$10,000 to \$100,000) 2. 100's of Thousands (\$100,000 to \$1 Mil) 3. Millions (\$1 to \$10 Mil) 4. 10's of Millions (\$10 to \$100 Mil) 5. Hundreds of Millions (>\$100 Mil)	Schedule Impact/Severity Estimated Range (workdays) <i>Assume the event happens, what is the potential impact?</i> 1. Days 2. Weeks 3. 1 - 3 Months 4. 3 - 12 Months 5. Year or longer	Probability 1. Very Unlikely (1 - 10% Probability) 2. Unlikely (11 - 35%) 3. 50/50 chance of occurring (36 - 64%) 4. Likely (65 - 89%) 5. Highly likely/Near certainty (90 - 99%)		Management Strategy 1. Avoid 2. Mitigate 3. Transfer 4. Accept 5. Optimize (Opportunities)	Mitigations Including due date for action assignments

APPENDIX B – RISK SCORING GUIDE

QUANTITATIVE RANKING

	1	2	3	4	5
Likelihood	Very Unlikely (1 - 10%)	Unlikely (11 – 35%)	50/50 chance (36 – 64%)	Likely (65 – 89%)	Highly Likely/ Near certainty (90 - 99%)
Cost Impact (\$)	Tens of Thousands (\$10,000 to \$100,000)	Hundreds of Thousands (\$100,000 to \$1 Mil)	Millions (\$1 to \$10 Mil)	Tens of Millions (\$10 to \$100 Mil)	Hundreds of Millions (>\$100 Mil)
Schedule Impact (workdays)	Days	Weeks	1-3 Months	3-12 Months	Year or longer

RISK MATRIX



APPENDIX C – GENERAL HAZARD CHECKLIST**Part A: Project Related****Engineering**

- Current design status / significant design development in detail design phase
- Complexity, constructability of design for both aerial and underground elements
- Increase in performance requirements/standards between now and final design
- Final design criteria more detailed than currently assumed
- Increased complexity (Civil and Systems Design)
- Increase in amount of underground construction
- Inadequate geotechnical information
- Insufficient research on existing facilities
- No precondition surveys of existing buildings/structures
- Requirements for new technology

Environmental

- NIMBY forces realignments
- Noise (Construction and Operations)
- Construction induced dust, vibration, settlement
- Ground Contamination
- Restrictions in hours of construction
- Holiday Moratoriums on construction work
- Disruption of Services
- Vehicle / Pedestrian conflict
- Major road and traffic diversions
- Access needs for Emergency Services

Third Party Impacts

- Potential impacts to public/private property
- Impacts to utilities
- Impacts to public transportation
- Loss of local business (Retail, Restaurants, Hotels)
- Potential for adjacent building damage
- Property taking and easements are underestimated

Logistics and Schedule Impacts

- Contract packaging and procurement – number of contracts
- Advance Utility relocations
- Contractor interference between adjacent segments
- Production rates slower than assumed

Systems – Procurement, Installation, Operations and Maintenance

- Procurement of new / additional rolling stock
- Communications
- OCS and Signaling
- Special Trackwork
- Traction Power / substations
- Station facilities

Part B: Programmatic

- Political advocacy for the project /
- Public acceptance / Local opposition groups
- Potential for major change in project alignments
- “Missing” segments within a corridor

- New Regulatory Requirements
- Potential for stoppages by other parties or situations
- Timeliness of FTA, State, City, and Local Agency permits
- Discovery of Archeological Sites
- Identification of Historic Sites

- Sources/Availability of funding
- Synchronization of projects and funding
- Inflation and increase in borrowing rates
- Major increase in raw material prices
- Cost Escalation due to delays in starting projects
- Fluctuations in US\$ exchange rates
- Fluctuations in property values

- Contracting Climate - Unacceptable bid responses
- Workload/Capacity of regional contractors / availability of skilled workforce
- Labor relations / regulations / disputes/ strikes
- Competing activity on selected sites/availability of access to work when required