



SHRP2's risk assessment product, Managing Risk in Rapid Renewal Projects (R09), is a highly flexible management tool transportation agencies can use to anticipate, assess, and manage risk for projects of any size and type. Through the iterative risk assessment process, agencies save time and money by identifying and mitigating risks earlier.

Figure 1: Ochoco Creek Bridge in Prineville, Oregon.

Using SHRP2's Risk Management Approach to Assess Risk on Projects of All Complexities

The Oregon Department of Transportation (ODOT) has implemented a new risk management process on a series of projects, including the Ochoco Creek Bridge replacement project (photo above).

ODOT used a risk assessment tool developed through the second Strategic Highway Research Program (SHRP2) to begin conducting comprehensive risk assessments in-house, saving both time and money. After realizing the benefits, ODOT developed a risk management framework and supplemental guidance materials to use the tool from project conception through construction. The Agency is now training its project delivery staff to apply the SHRP2 tool to projects of different scopes and complexities, with a goal of integrating risk management into its overall project delivery process.

The Challenge: Calculating and Managing the Impact of Risks

State Departments of Transportation (DOTs) commonly hire consultants to complete risk assessments on large projects due to the complex methodology of traditional assessments (i.e., full probabilistic risk assessments), and the Federal Highway Administration's (FHWA) requirement to conduct cost estimate reviews and risk assessments/analyses on projects that cost \$500M and higher. However, complexities and risks may be present in projects of any size. If left unmanaged, these risks could lead to cost overruns, schedule delays, and unmet stakeholder expectations.

DOTs know that risk assessments can save their projects from schedule delays and cost overruns, but traditional assessments are not always practical for small or medium sized projects. Risk assessment could be applied more universally if there was a simplified approach that was customizable to the unique attributes

of each project and could be done in-house.



Figure 2: ODOT participants complete exercises using the R09 template during a training class in Salem, Oregon.

SHRP2 Solution: A Highly Flexible Risk Management Process and Template

Managing Risk in Rapid Renewal Projects was the ninth research project in the SHRP2 Renewal Focus Area and is also known as Renewal 09 (R09). The product uses a highly flexible Excel-based template to guide teams through a comprehensive risk management process to identify, assess, analyze, and manage risks that are unique to each project. The accompanying **R09 Guidebook** provides additional tools to assist with each step. The ability to perform these customized assessments in-house saves money in the short and long term, and familiarizes project teams with potential challenges ahead.

During a two-day training workshop hosted by FHWA, ODOT staff applied the product's iterative process and **template** using a hypothetical case study (QDOT project) to:

- Holistically identify potential risks
- Determine the likelihood of risk occurrence
- Calculate the associated schedule, cost, and disruption impacts
- Devise strategies to monitor and mitigate risks from planning to construction
- Assess the overall impact of mitigated risks
- Explore how to implement a risk management plan as part of their overall project delivery process

This training was developed by FHWA in the National Highway Institute (NHI) format. It was designed to be interactive and incorporate adult learning principles.

Using the R09 Risk Management Template

The R09 template guides agencies step-by-step through the risk management process. DOTs can adjust the template settings to fit their project’s unique characteristics by defining the project’s delivery method, base cost, and base schedule; and by identifying risks. The template then calculates the impact of unmitigated and mitigated risks on schedule, cost, and disruption.

The template includes the following resources and features:

- A Help Guide on every spreadsheet within the template
- A comprehensive **user guide** to better understand risk management terminology
- Clearly defined input cells that indicate where to enter data, and output cells that provide analysis results
- The ability to prioritize the most severe risks by project phase in a risk register before and after mitigation strategies are applied
- The option to “retire” a risk if a DOT re-assesses risks on the same project in the future¹
- Visual graphs (tornado diagram) showing the most severe unmitigated and mitigated risks (see Figure 4)
- A summary report that outlines customized selections from the template to describe risks, mitigation actions, and unmitigated and mitigated cost and schedule. This can be shared with the project team, DOT management, or the public to advocate for project resources and proposed strategies

R09 Risk Management Training Goals

Enhance DOT’s capability to conduct risk/opportunity management assessments.

- Identify project conditions and performance requirements where simple and complex risk/opportunity management (RM) methods can be applied
- Identify the steps of the RM process
- Conduct RM assessments for simple projects
- Formulate a RM plan for a typical transportation project (QDOT project)
- Document, interpret, and apply the results obtained with the RM process
- Communicate the results of the RM process
- Apply the R09 template and implement results

R09 Risk Management Process

The 7-step R09 risk management process, described below and in Figure 3, helps DOTs identify and mitigate the most severe risks to reduce overall construction costs and time. Through an FHWA-led training, ODOT personnel applied the R09 risk management process on a hypothetical project, called the QDOT case study. The QDOT example is referenced throughout the R09 Guidebook. It is used during the training because it aims to minimize three key criteria—cost, schedule, and disruption—and is a project that involves multiple risks in several of the project phases. Read **additional case studies** to see how DOTs are using the process on real-world projects.

1 Project Scope/Strategy/Conditions

The first step of the process includes familiarizing the participants with the project scope, strategy, and conditions. Elements such as: planned approach, design alternatives, funding, technical conditions affecting the project, political and external conditions, and cost and schedule estimates are discussed among the participants to provide a firm understanding of the project and enable early thinking about potential project risks and opportunities.

2 Structuring

Structuring is the second step, which involves defining the base project scenario for cost and schedule/duration (base performance). The base performance does not account for any project risks, which are typically accounted for by way of contingencies and intentional schedule float. The base performance is determined by the R09 template by entering cost and duration information per project phase (e.g. planning, scoping, design/environmental process, procurement, final design, construction) without considering any built-in contingencies and intentional schedule floats. The base performance will be compared against the unmitigated and mitigated project performances later, which include unmitigated risks and some mitigated risks, respectively. Table 1 includes the base project performance results from the QDOT example.



Figure 3: R09 Risk Management Process Steps

Table 1: Base Project Summary

Base Cost in Year of Expenditures (YOE)	\$ 17.02 M
Construction Notice to Proceed	07/01/2011
Construction Completion Date	10/30/2012

¹A risk can be “retired” under three circumstances: 1) after the risk occurs and is incorporated into the base cost and schedule performance, 2) when the risk can no longer occur (e.g., a design risk after the design phase is completed), or 3) after the risk is mitigated.

3 Risk Identification

The next step is Risk Identification, which also includes identifying opportunities. The purpose is to identify risks and opportunities that could affect the project’s base cost and schedule. Risks can degrade project performance, while opportunities can enhance it. Risks and opportunities are documented in the R09 template and categorized according to when they are most likely to occur in the project (e.g. planning, scoping, ROW, construction, etc.). The outcome is a comprehensive, non-overlapping list of risks and opportunities, rather than screening out issues prematurely.

“The R09 product can assess risks in a quantitative way, in terms of time and costs. Having quantitative data may help ODOT with decision making, and will also help us to work effectively with stakeholders and the public.”
 – Molly Cary, ODOT

4 Risk Assessment

Risk Assessment is the fourth step of the process. It involves assessing probability of occurrence, mean cost and schedule impact, and mean disruption impact (if included as a performance metric) for each identified risk and opportunity. Assessments are conducted using the Delphi technique, which uses project team consensus and input from subject matter experts. The R09 template provides two methods to conduct the assessments: 1) a qualitative assessment, which uses pre-defined ratings that are linked to a range of values, or 2) a quantitative assessment, which uses direct mean values. Both methods are used to determine probability of occurrence (percentage of occurrence), mean cost change (in dollars), mean duration change (in months), and mean disruption change (in million-hours). Once all risks and opportunities are assessed, the R09 template organizes and prioritizes them according to mean severity to help the project team focus on addressing the most severe risks and beneficial opportunities. Table 2 includes the top five unmitigated risks from QDOT’s case study.

Table 2: Top 5 Risks from QDOT’s Unmitigated Risk Register (ranked by mean severity)	
1.	Provide new lighting throughout project
2.	Uncertainty in construction cost inflation rate
3.	Uncertainty in ROW inflation rate
4.	Unwilling sellers
5.	QDOT helps city pay for water and sewer line relocation

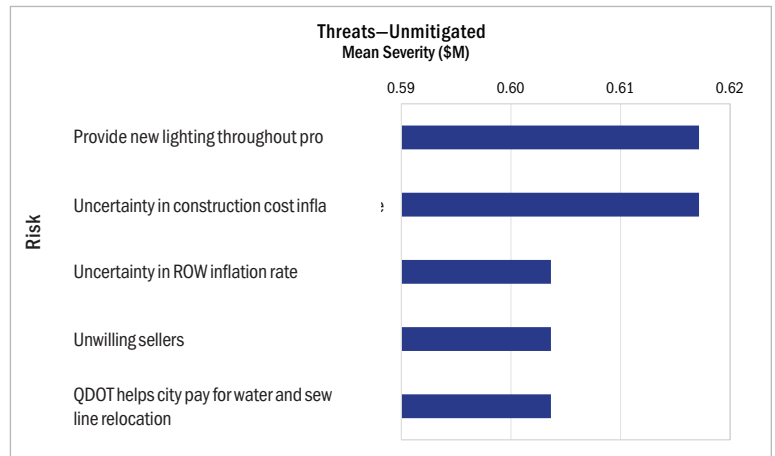


Figure 4: Tornado diagram of unmitigated risks produced by the R09 template based on the QDOT case study.

5 Risk Analysis

Step 5 involves Risk Analysis, which combines the base performance with risk assessments from steps 2 through 4, to determine the impact of each risk and opportunity on schedule, uninflated and inflated cost, and disruption (if included as a performance metric) if the risks remained unmitigated. Table 3 compares the base project performance to the unmitigated project performance for the QDOT project. Understanding the impact of unmitigated risks and opportunities helps DOTs make informed decisions about mitigation actions and resource allocation from planning to construction.

Table 3: Comparison of Base Project Performance and Unmitigated Project Performance			
	Base	Unmitigated	Difference
Base Cost (YOE)	\$ 17.02 M	\$ 23.00 M	\$ 5.98 M
Construction Notice to Proceed	07/01/2011	09/18/2011	2.6 months
Construction Completion Date	10/30/2012	02/11/2013	3.4 months

6 Risk Management Planning

Risk Management Planning is the process of identifying potential actions to mitigate the top risks and opportunities (in terms of mean severity) from the project's unmitigated risk register. The R09 template offers a capability not included in other risk assessment templates: it allows users to evaluate the cost effectiveness of implementing mitigation strategies to determine if the benefit of the mitigation outweighs the cost/time to implement it. Table 4 lists potential actions to mitigate the most severe risks in the QDOT case study.

Risk Description	Mitigation Action
Provide new lighting throughout project	Negotiate cost-sharing agreement with the city
Unwilling sellers	Make reasonable early offer
Additional maintenance of traffic required	Reduce traffic demand during closures
Accelerating pace of development in interchange area	Coordinate with city—stop issuing permits for new developments
Cannot use city sewer system for project runoff (or city charges for use)	Help city pay for water and sewer line relocation

The R09 template then helps the project team assess the impact of the mitigations (using mean values or pre-defined ratings) on project cost and schedule. This results in a mitigated risk register, which includes the severity calculation for all risks and opportunities, including the ones that were mitigated. Once mitigation actions are applied, the risk ranking by mean severity is no longer the same as in the unmitigated risk register (Table 2). For example, "Provide new lighting throughout the project" is no longer one of the top five risks once the mitigating action of "negotiating cost sharing with the city" is considered. In other words, its risk severity has decreased by implementing this mitigation. Table 5 includes the top risks from QDOT's mitigated risk register. Comparing the mitigated and unmitigated risk registers can help a DOT quantify the impact of the most severe unmitigated risks and determine the impact of the proposed mitigation actions.

1. QDOT helps city pay for water and sewer line relocation
2. Uncertainty in construction cost inflation rate
3. Uncertainty in ROW inflation rate
4. Change in environmental documentation
5. Uncertain Design/Build contracting market conditions at time of bid

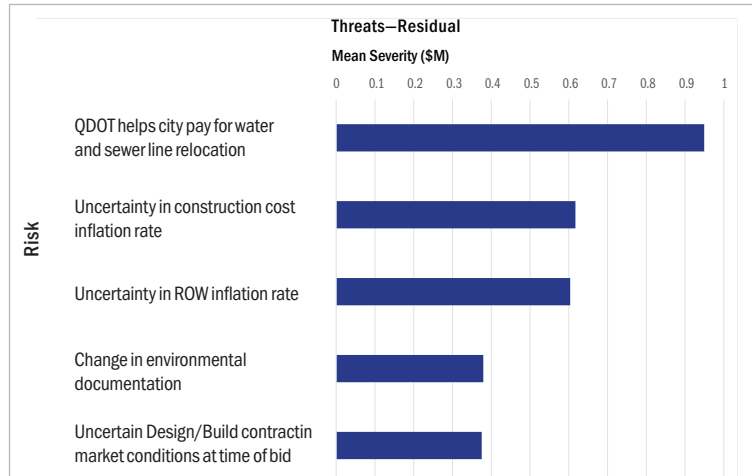


Figure 5: Tornado diagram of mitigated risks produced by the R09 template based on the QDOT case study.

The next step consists of a mitigated performance analysis to determine the cost, schedule, and disruption (if selected as a performance metric) with the selected mitigations. The Mitigated Project Performance of the R09 template illustrates the cost, schedule, and disruption results with the selected risk and opportunity mitigations. Furthermore, it compares the base, unmitigated, and mitigated performance as shown in Table 6. The last column of Table 6 illustrates the anticipated project savings on QDOT's project by applying the previously identified mitigations. This helps agencies save time and money, budget more accurate amounts of funding, and plan more realistic schedules.

	Base	Unmitigated	Mitigated	Mitigation Savings
Base Cost (YOE)	\$ 17.02 M	\$ 23.00 M	\$ 22.21 M	\$ 0.79 M
Construction Notice to Proceed	07/01/2011	09/18/2011	09/05/2011	13 days
Construction Completion Date	10/30/2012	02/11/2013	01/15/2013	27 days

7 Risk Management Implementation

The final step of the process involves identifying the persons who will be responsible for implementing each mitigation and ensuring that risks are monitored throughout the life of the project. When implementing the risk management plan, it is critical to identify roles, responsibilities, authority, and resources. Strong commitment from, and communication among, all parties is essential so the Risk Management Plan can be updated based on changing project conditions.

Best Practices for Instituting a Risk Management Program

Want to setup your own risk management program? FHWA and ODOT recommend strong organizational support, including a risk management champion at the leadership level, and someone dedicated to applying and integrating the process and training project teams. This organizational support is critical to the success of implementing and integrating risk management at your DOT. Long term commitment from DOT management is crucial in order to institute this program and make it part of the project delivery process within your DOT.

FHWA also recommends the following steps to help set up and institutionalize a risk management program.

- Develop risk management policies and procedures
- Offer regular training sessions to train staff over time
- Contact other transportation agencies implementing the R09 Risk Management Process to collect best practices (see Table 7)

Table 7: Agencies Using the R09 Risk Management Process

DOT	Point of Contact	Phone	E-Mail
Alabama	Vince Calametti	251-470-8204	CalamettiV@dot.state.al.us
Alaska	Carolyn Morehouse	907-465-8140	carolyn.morehouse@alaska.gov
Arizona	Madhu Reddy	602-712-8965	MReddy@azdot.gov
FHWA Federal Lands	Victoria Peters	720-963-3522	Victoria.Peters@dot.gov
Florida	Greg Davis	850-414-4170	Greg.Davis@dot.state.fl.us
Georgia	Binh Bui	404-608-4798	bbui@dot.ga.gov
Minnesota	Jenny Read	651-366-4602	jennifer.read@state.mn.us
Oregon	Lea Ann Hart-Chambers	503-986-3798	Lea.Ann.Hart-Chambers@odot.state.or.us
Pennsylvania	Brian Shunk	717-214-1276	bshunk@pa.gov
Puerto Rico	Nydia R. Daniels Vigo	787-721-8787. Ext. 1400, 1401	ndaniels@dtop.gov.pr
Puerto Rico	Ray Morales	787-721-8787. Ext. 1453	RAMorales@dtop.gov.pr
Wisconsin	Larry Jones	608-267-7954	larry.jones@dot.wi.gov
Wisconsin	Sharon Bremser	608-215-5317	Sharon.Bremser@dot.wi.gov

Product Benefits

Agencies that adopt this new in-house risk management approach can benefit from:

- Effectively identifying and evaluating the project's most severe risks and their impact on project cost, schedule, and disruption
- Creating a risk management plan to mitigate and monitor risks
- Developing a greater understanding of the project's scope, conditions, and strategies earlier in the planning stages and prior to construction
- Using the risk assessment data to explain proposed project strategies and to advocate for necessary project resources
- Including key project stakeholders in the risk-management process, which leads to the identification of more risks, opportunities, and creative mitigations
- Creating understanding and buy-in among stakeholders
- Collaborating across organizational boundaries to create and leverage the above-mentioned benefits



Figure 6: ODOT participants collaborate during the training.

“ I see the power in risk management, and the R09 template is flexible and simple enough for our project managers to apply it to nearly every project. By proactively identifying risks and mitigation actions, we can talk to stakeholders about project needs early, and avoid costly, unexpected surprises down the road. ”

- Lea Ann Hart-Chambers, ODOT



Save Lives



Save Money



Save Time

Resources to Help You Use SHRP2's R09 Risk Management Product

The product's **guidebook and other materials** are available on the Transportation Research Board Website: <http://www.trb.org/Main/Blurbs/168369.aspx>.

To learn more about how your agency can save time and money by using R09 to manage risk in projects of all sizes, visit <http://www.fhwa.dot.gov/GoShrp2/Solutions/Renewal/R09> or contact:

- Carlos F. Figueroa, P.E. (FHWA Office of Infrastructure) at carlos.figueroa@dot.gov
- Keith Platte, P.E. (AASHTO) at kplatte@aaashto.org
- Lea Ann Hart-Chambers (ODOT) at lea.ann.hart-chambers@odot.state.or.us



Implementing SHRP2

The second Strategic Highway Research Program (SHRP2) is a national partnership of the Federal Highway Administration, the American Association of State Highway and Transportation Officials, and the Transportation Research Board. Together, these partners conducted research and are deploying resulting products to help the transportation community enhance productivity, boost efficiency, increase safety, and improve the reliability of the Nation's highway system.

The Oregon Department of Transportation (ODOT) applied Managing Risk in Rapid Renewal Projects on various transportation projects as part of the **SHRP2 Implementation Assistance Program**.