

Proceedings

Cost Estimating and Cost Management Capacity Building Workshop

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Executive Summary

In this workshop, participants heard presentations from the Federal Highway Administration (FHWA), the American Association of State Highway and Transportation Officials (AASHTO), and various state departments of transportation (DOTs) on the state of best practices in risk management and risk assessment. The event also featured small- and large-group discussions aimed at developing an action plan and research agenda by the event's end. This document summarizes the presentations and discussions from the 2010 workshop.

Welcome and Opening Comments



Laurie McGinnis



Jim Cheatham

Moderator: Laurie McGinnis, Director, Center for Transportation Studies (CTS), University of Minnesota

Speakers: Jim Cheatham, Director of Planning, Federal Highway Administration; Matt Hardy, Program Director of Policy and Planning, American Association of State Highway and Transportation Officials; Tim Henkel, Modal Planning and Program Management Division Director, Minnesota Department of Transportation

Laurie McGinnis, director of the Center for Transportation Studies (CTS) at the University of Minnesota, welcomed participants to the 2010 capacity building workshop, the third in a series dating back to November 2007. That first workshop focused on cost estimating and cost management in the planning process. The second workshop, held in April 2008, focused on cost estimating and cost management in the design and project development process. "This year our focus is on risk assessment and risk management and the associated estimating for contingency that goes along with it," McGinnis explained. "We are here to learn, exchange information, and work. So bring your best ideas forward to help us flesh out what some of the next steps around cost estimating and cost management need to be with respect to research, implementation, and action."

She then described some related efforts CTS has embarked on including its work with the Minnesota Department of Transportation (Mn/DOT) on a comprehensive effort to strengthen the agency's project cost estimating and cost management processes based on guidance from NCHRP Report 574. "CTS has been involved from the beginning...and is

now working with Mn/DOT on training, implementation, and integration of these activities and principles."

McGinnis then introduced James Cheatham, director of planning with FHWA. "I'm eager to hear what [your agencies] are doing and how things are working," Cheatham said. He explained that FHWA now asks DOTs to provide, in their early project documents, the "real [estimate] number at the year of execution. We don't ask how you get there, but if you don't have a methodology to come up with the real number, at least use the minimum 4 percent to estimate where you're going," he said, adding that there are newer and better tools available to help in this process. "As we share ideas here and discuss the different estimating tools available, we can go back to our agencies and work to narrow the gap between our initial, and often publicized, estimates and the actual final project cost. We know we won't be exact, but maybe we can get our estimates closer. To move in this direction, FHWA encourages you to use risk-based cost estimation...cost estimating and cost management is as important to us as it is to you."

Next, Tim Henkel, modal planning and program management division director



Tim Henkel



Matt Hardy

with Mn/DOT, expressed his appreciation to audience members. “This is a great turnout given the travel budget situation that exists for all of us, and I appreciate your effort to get here.” He then offered some background on how cost estimating and cost management became important issues within transportation agencies. “DOT cost estimates were costing [agencies around the country] public trust,” Henkel said. “Using resources from the Transportation Research Board (TRB) and National Cooperative Highway Research Program (NCHRP), Neil Pedersen with the Maryland DOT got things rolling, which has resulted in some of the products that will be presented at this workshop. Those efforts gave DOTs across the nation and beyond a starting point for understanding the issue and providing direction on how to do business. Those efforts were the impetus for the work Mn/DOT has done, and [they] are making a difference in how we approach cost estimating.”

According to Henkel, Mn/DOT still has a difficult time garnering public trust because it has had a difficult time delivering projects on time and on budget. “We’ve taken this issue head on and are

now using tools like those [Stuart Anderson from Texas A&M University] has developed. We are partnering with FHWA to implement guidelines, policies, and strategies that enable us to move forward. This workshop is one component of the work we’re doing to better understand this issue. This is a place to learn from each other and to discover where we have gaps that require more research to establish best practices necessary for us all to be successful.”

Matt Hardy, program director of policy and planning with AASHTO, agreed. “This workshop is very important to carrying on what has been going on [in DOTs with regard to cost estimating and cost management] over the past two years,” Hardy said. He then referenced a paper published in the early 1990s called “A Desire Named Streetcar.” In it, the author examined data from the 1980s and found that with nearly all road construction projects across the country the benefits were overestimated and the costs underestimated. “We’ve come a long way since then,” Hardy said, noting that with aids such as Report 574, “We are getting better and better at more accurately estimating [project] costs and benefits.”

Needs – Revenues – Challenges



Stuart Anderson

Speaker: Stuart Anderson, Professor, Department of Civil Engineering, Texas A&M University

Professor Stuart Anderson of Texas A&M University acknowledged that state highway agencies face major challenges in controlling project budgets between project initiation and construction completion. To address this problem, he explained, a diverse research team set out to develop a guidebook on highway cost estimation management and project cost estimation practice that would help DOTs achieve greater consistency and accuracy between long-range transportation planning, priority programming, preconstruction estimates, and final design.

Anderson presented highlights of this project, the results of which were published as the Transportation Research Board's (TRB) National Cooperative Highway Research Program (NCHRP) Report 574: *Guidance for Cost Estimation and Management for Highway Projects During Planning, Programming, and Preconstruction*. Anderson was part of the team involved in developing this guidebook, which explores strategies, methods, and tools to develop, track, and document realistic cost estimates during each phase of the process. Other team members include Keith Molenaar with the University of Colorado, Cliff Schexnayder with the Des E. Web School of Construction at Arizona State University, and Jennifer Shane, formerly a research assistant at the University of Colorado and now assistant professor at Iowa State University.

The guidebook is essentially a framework for developing more detailed processes and procedures for cost estimating and cost management, Anderson said. He then provided some additional background on the research conducted to develop the report. "Our boundaries were for the first estimates, planning, and the

engineering; this guidance does not cover cost estimating and cost management for the construction portion of a project." The guidebook is structured around a strategic approach to addressing cost escalation, with the recommended strategies, methods, and tools aligned with three main project development phases: planning, programming and preliminary design, and final design. He noted also that the guide includes a suggested implementation plan geared to individual state DOTs and outlines ideas for industry-wide implementation as well.

Anderson next described some of the advances made since Report 574 was published. He first discussed Mn/DOT's newly published *Cost Estimation and Cost Management (CE/CM) Technical Reference Manual*, which outlines the steps, policies, and tools the agency uses to achieve accuracy, accountability, and consistency in estimating and managing costs during the planning, scoping, design, and letting phases of project delivery.

Next, Anderson described other recent projects on which he, Molenaar, and Schexnayder collaborated following their Report 574 work. These follow-up efforts resulted in two additional guidebooks. NCHRP Report 625: *Procedures Guide for Right-of-Way Cost Estimation and Cost Management* details practical and effective approaches for developing right-of-way (ROW) cost estimates and for then tracking and managing ROW cost during all phases of project development from planning through final design. The second guide, NCHRP Report 658: *Guidebook on Risk Analysis Tools and Management Practices to Control Transportation Project Costs*, provides an in-depth treatment of specific risk-related management practices and analysis tools.

These reports can be viewed at: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_625.pdf and http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_658.pdf.

The AASHTO Technical Committee on Cost Estimating (TCCE) is also working on a new publication to further help DOTs and other transportation agencies develop or improve their cost-estimating policies and guidance, Anderson reported. This new publication, NCHRP 20-7 Task 278, is tentatively titled “A Practical Guide to Estimating.” Chapters have been drafted by various volunteer authors and a team of supporting committee members who review applicable research and agency practices and work to present information using suitable language and suggestions intended to further the state-of-the-practice in highway project cost estimating. The goal is to create an AASHTO-approved estimating process.

Finally, Anderson referenced two other Report 574 follow-up projects. One is a technical report done in cooperation with Texas A&M, Texas DOT (TxDOT), and FHWA called *Synthesis on Construction Unit Cost Development*. The other

project is a Texas A&M Master of Science student thesis titled “Sliding Scale Contingencies for the Highway Construction Project Development Process.”

The TxDOT synthesis identifies how state highway agencies develop unit prices for construction and maintenance projects. The report can be viewed at: <http://tti.tamu.edu/documents/0-6023-1.pdf>. The student thesis contains a set of sliding scale contingencies for estimating contingency on highway projects taking into consideration the effect of major factors that impact contingency application. This report can be viewed at: <http://design.transportation.org/Documents/SLIDING%20SCALE%20CONTINGENCIES.pdf>

“So let’s talk about the current environment,” Anderson said in his closing remarks. “We’re in the midst of an economic downturn, and it’s hard to apply new techniques when we are rushing projects out the door. We’re all dealing with resource constraints...there are many issues and challenges ahead of us, so let’s use this workshop to brainstorm some potential solutions.”

Minnesota DOT Experiences



Mike Ginnaty



Jean Wallace

Speakers: Mike Ginnaty, Director of Project Scope and Cost Management, Mn/DOT;
Jean Wallace, Director of Project Scoping Section, Mn/DOT

Like many other state transportation agencies, Mn/DOT is often the subject of scrutiny and criticism regarding cost overruns. In efforts to quell this negative press and, in fact, get a better handle on project budgets, Mn/DOT began a cost estimating process improvement and organization integration project in October 2006. In this presentation, Mike Ginnaty, director of project scope and cost management with Mn/DOT, provided an overview of this, and related, initiatives.

One major change Mn/DOT made to its estimating process involves looking at total project costs—not just construction costs—including engineering, right-of-way, and other elements like utilities, railroad agreements, and municipal agreements, Ginnaty explained. Mn/DOT's cost estimating/cost management policies now require total project cost estimates (TPCE) to identify risks and estimate contingencies. "There is no program contingency," Ginnaty continued. "All contingency is at the project level, and unused contingency is returned to the program. Overall, we've made estimating, managing, and controlling costs a department-wide priority."

The TPCEs are developed by taking known base estimate elements such as engineering, project construction costs, detours and haul roads, right-of-way, utilities, incentives, and others and adding in both pre- and post-letting contingency. "At the end of scoping, the TPCE is the baseline cost estimate," he explained.

"In 2007, we started coordinating the cost estimating/cost management project with a separate scoping initiative and completed implementation of both in early 2008," Ginnaty said. He acknowledged, however, that some challenges re-

main. "We still need earlier coordination, especially with external stakeholders, and we want to shift resources to earlier in the project development process. We need to better understand and provide risk management plans as well."

He went on to discuss Mn/DOT's new "decision to build" policy; that is, the financial decision point at which Mn/DOT commits to a project. "At the entry into the STIP, [Mn/DOT] is making a financial decision for a project based on the scope, cost, timeframe, and that it is the right project for that cost. We track the decision to the build number as the project goes through the STIP [State Transportation Improvement Program], through substantial completion of construction, and final closeout."

Because Mn/DOT has historically looked at only construction costs, the agency currently does not have a good method for tracking total project costs, Ginnaty added. "We are getting better at documenting our estimates, but right now it's difficult to track estimates and see how they progress over time." The short-term plan is to identify improvements that can be made to Mn/DOT's current data warehouse and use that information to help manage projects. Long term, the hope is to link actual cost to TPCE elements and better define these in order to more accurately track estimates versus actual inflation.

"Really, the essence of our office is to achieve earlier and more comprehensive front-end project planning," Ginnaty said. "We want to deliver the right projects on time and on budget. The key is the right project...that ties back to our program goals and objectives which in turn ties into our long-range plan."

For more information, visit the Mn/DOT scoping and cost estimating

website at: www.dot.state.mn.us/cost-estimating.

Jean Wallace, director of Mn/DOT's Project Scoping Section, provided additional information on the agency's new scoping process initiative. She also talked about the project management-related peer review Mn/DOT went through in 2009.

To begin, Wallace reiterated some of the many benefits good scoping provides. "It really enables early identification of what is in the project and what is not and helps with earlier identification of potential risk and conflict," she said. In addition, good scoping makes it possible to better align projects with performance goals and provides better cost estimates and schedules, and all of that facilitates greater public trust.

Mn/DOT's new scoping process emphasizes the use of early, comprehensive, documented decisions, and incorporated a formalized change process. "We looked at three phases in the scoping process where we want the work to occur," she said. "Early on in the planning is where we analyze performance gaps, determine what the performance-based needs and purpose are, and determine which projects to scope. Then, in the scoping phase, we produce a scope detailed enough to define an accurate cost estimate and project schedule. We move on to programming where we determine which projects to forward to area transportation partnerships (ATPs), and then we prepare the STIP."

She described some of the remaining challenges with the new process and noted the need to continually communicate the value to project managers of early scoping. "We also continue to focus on earlier coordination both internally and externally and are working to make sure that we have representation from all phases of the project and that these people have input early on in the process."

As a next step, Mn/DOT has recon-

vened the project scoping committee to work on further improvements. "We've set a goal to ensure our scoping process is consistently applied; we have six objectives to meet that goal based on three areas: review, refine, and reach," she said. "In the review, we will evaluate the scoping process to see where we are. We will refine the process with clearly defined roles and responsibilities and will address complexity and flexibility. Finally, we're reaching forward by developing more guidance on scope management, incorporating risk, and developing a process to integrate new initiatives, laws, and policies."

Wallace next discussed Mn/DOT's project management peer review. "We wanted to benchmark where we were with our current project management practices," she explained. "We viewed this as an initial step to our change management process. It was also an opportunity to check on industry best practices and to build from our current successes throughout the department."

Essentially, the objective of the peer review was to create, implement, support, and sustain a project management environment. "Project management aligns with Mn/DOT's strategic vision," Wallace said. "It's a key element for successfully implementing our strategic directions of safety, mobility, innovation, leadership, and transparency."

This initiative involved a review of related national studies including AASHTO Domestic Scan 07-01 (NCHRP 20-68A), "Best Practices in Project Delivery Management." Wallace highlighted two findings from this study of particular interest to Mn/DOT. First, successful systems can be centralized or decentralized, but roles and responsibilities must be clearly defined and understood. The other finding of note was that successful systems provide for hand-offs from one discipline to another and from one work phase to another, ensuring a seamless

transition between phases or from one manager to another, to ensure continuity throughout the project development.

A second study Mn/DOT reviewed was NCHRP 20-69, NCHRP web-only Document 137: *Guidance for Transportation Project Management*. This study documents a number of project management best practices from agencies around the country.

Mn/DOT also created a steering committee comprising a cross section of internal and external partners to help develop the peer review agenda. “It provided a great opportunity to partner with FHWA, other state DOTs, CTS, and [consulting group] CH2M HILL,” Wallace said.

Through a series of extensive group and individual interviews with Mn/DOT project management staff, peer review panel members learned about Mn/DOT’s current approaches. “We found numerous best practices including widespread implementation of the scoping process and support for cost estimating and cost management. We also found that Mn/DOT has a strong project delivery focus and culture; we know how to deliver projects and are empowered to do that.”

The panel also observed that the term “project manager” has many definitions within Mn/DOT, which often results in unclear transitions in the project management role and inconsistency in responsibilities. “We also noticed gaps in

training for project managers...we train them initially, but there’s not much ongoing refresher-type training,” Wallace said. “Additionally, our current project tracking software/system doesn’t really provide the capabilities needed for advanced project management.”

The findings of the peer review were summarized in a final report published in January 2010. In it, the review panel pointed to several recommendations and action items including the need for Mn/DOT to clarify the authority and responsibilities of project managers, more broadly establish the use of project management plans, complete project-level risk management plans, explore project management and other career tracks, and develop an implementation plan for long-term sustained change.

“We are now facilitating development of project management plans on four of the Chapter 152 bridge improvement projects,” she explained. “We are also exploring resource-loaded cost schedules and an earned value pilot project. We are funding basic project management training based on the Project Management Body of Knowledge (PMBOK) guide, and we are encouraging Project Management Professional (PMP) certification through the Project Management Institute (PMI).”

For more information, view the peer review summary report at: <http://www.dot.state.mn.us/cost-estimating/peer-review/index.html>.

Small-Group Discussion

During this session, participants were divided into two separate work groups to discuss the various challenges faced by states in terms of cost estimating and management from a planning perspective. The discussions centered around three central questions:

1. How much early project development/planning do you do when establishing your baseline cost estimate?
2. How do you currently ensure that a project's baseline estimate best matches its true final cost? If there's a difference—how would you like to do it?
3. What skills and competencies do we need in our workforce to effectively incorporate cost estimation and cost management into our organizations' ways of doing business?

Through separate brainstorming sessions, each group came up with lists of issues and then chose the key points, which were summarized by a group representative to the entire group. Following is an excerpt from those summary reports.

How much early project development/planning do you do when establishing your baseline cost estimate?

Group 1

- Idaho: Doesn't do much now; projects proposed at district level; decentralized function; not sure what data are used for estimate and at what level of detail
- Oregon: Design centralized; no history of cost database for relevance
- Washington: First category, little pre-design 0-2%. Second category, some design done; project bought off the shelf
- Georgia: ROW tool developed in-house; don't always know what 120W they have; manually updated
- FHWA (Federal Lands): Early estimate based on scope from partners
- Minnesota: Formula based on project type—calculate based on length (road-mile); use TRANSPORT; incentive to perform and build in; moving to all projects; update database quarterly; cost estimate office updates

Group 2

- Montana: Very little
- California: Fair amount for construction cost, but little for total project cost
- FHWA: Require that total cost of project is included for major projects (over \$500M)
- Nevada: Working closely with planning units up front; seeing a lot of "hidden costs" that haven't been seen in the past
- Colorado: "Baseline" estimate is not usually done; don't ever go back to that estimate

Group 3

- Done by each member entity when they enter project (FL, WA, NV, UT)
- Breakdown of cost not required
- Minnesota puts themselves at a different position than federal requires
- Utah: Never time to follow process
- Florida: Different approaches per districts; require all to use estimating tool; hired consultant to do detailed scope in one district
- Washington: Cost estimating guides developed

- Design allowances put in
- Contingencies built
- Time crunch more recent now with all the stimulus projects, extra projects
- Minnesota: Working with old processes while transitioning to new processes; challenging
- Minnesota and Utah: Difficult to keep current with scope over term of longer projects; changes occur from original scope
- Utah: Project delivery method changes; try to get money committed; doing more with design/build
- Minnesota: Trying to move toward design/build
- Nevada: Study showed estimates are not very accurate by the end of project
- Washington: Not locking in design money; preference in process; more design equals more accurate cost vs. estimate

How do we ensure that a project’s baseline estimate best matches its true final cost? If there’s a difference—how would you like to do it?

Group 1

- Georgia: A lot of contingency; documentation requirements/templates
- Minnesota: What stage are we doing estimate?
- Environmental Impact Statement (EIS), others, MPOs in metro plugging in an estimate; sometimes project scope doesn’t match partners
- Washington: Separate total to estimate risk once project cost is estimated; cost estimation validation process (big projects)
- Colorado: Spreadsheet template that estimates for multiple items; once project goes into design, people tend to pick default or high estimate
- Maryland: Planning—cost per lane mile; guidance for developing estimate; design—have spreadsheets with programs/area
- Georgia: Formula based on type of project; typical section and quantities > planning; contingencies ranging from 15% (rural) to 30% (urban)
- Idaho: Annual update—5% increase for inflation; could make change with justification; certain percent change with district engineer’s approval
- Maryland: Yearly annual updates approved by administrator; big changes have to be justified
- Oregon: More qualitative; testing and validating solutions

Group 2

- Minnesota: Documentation! Level of detail needed to compare estimate to final costs is missing
- Have to have information that feeds estimates, preliminary layouts, etc.
- Montana: Not doing any engineering in step phases. Scope not signed until environment documents are done. Having scoping document and not being allowed to change is key to staying on cost. Important to include what is and is not included in scope
- FHWA: Change management team is important; California has a document; Mn/DOT has district-level group (same group agreeing on scope) that approves changes
- Also important to have contingent to account for unknown. Mn/DOT includes a percent but it’s not standard
- Important to track changes/contingents so you have some data to rely on for future

estimates

- Having champions at top levels
- FHWA: Can look at what inflation (risk) is now and what we projected when projects were scoped
- Nevada: Percentage planning level, risk is assessed and contingency determined. Higher risk = more percent contingency

Group 3

- Nevada: Penalties for engineers missing costs/overruns
- Washington: Projects over \$10 million must have “risk reserve”
- Two-year biannual budget approved by legislation
- Contingency 4%
- Must be documented risk
- Minnesota/Washington: Scope change approval process, as needed
- Request more money
- West Virginia: Scope drives cost; seems like it always goes up
- Utah: Constrain costs to scope; often must trim back scope; additive building—option to address scope up; “What can you give us for this amount of money?” Get creative with options; project manager assigned to project start to finish; consistency on project, better manage costs; documenting actions—what’s included and what’s not included
- Virginia: Most projects privately funded; managed more highly

What skills and competencies do we need in our workforce to effectively incorporate cost estimation and cost management into our organizations’ ways of doing business?

Group 1

- Conflict resolution
- Knowledge of design to construction
- Unbiased perspective > be willing to hear changes; honest broker
- Statistical background
- Knowledge of economics > inflation
- Reward good project management (incentive/disincentive)
- Work with diverse groups and in teams
- Understand difference between risk and contingency
- Project management foundation (training to continuing education)

Group 2

- If move toward risk-based estimate, need basic risk training (stats, etc.)
- Cross training in University between engineer and planning. Internal training could provide this too
- Very dependent on broad, deep experience
- People that understand and can be dedicated to estimating
- Shift in culture

Group 3

- “Accuracy is data dependent”
 - May not have enough data to do accurate estimate
 - GIS getting more info, but it’s underused; should tap into this more
- Utah: More well-rounded background experience, bigger picture
- Washington: Offices with well-rounded background are more accurate in estimating
- Rotation with construction design/build: New employee program used in past and was successful
- Florida: Professional Engineering training program; work in all departments; two-year program
- Nevada: Better tools; more efficient; required to use template for construction cost/ estimates
- Training! First thing cut but we need this
- Washington: Retain talent; groom expertise and work to keep it

Findings from NCHRP 8-60—Guidebook on Risk Analysis Tools and Management Practices to Control Transportation Project Costs



Keith Molenaar

Speaker: Keith Molenaar, Professor, University of Colorado Boulder

Professor Keith Molenaar of the University of Colorado at Boulder presented highlights from the recently completed NCHRP Project 8-60 task, published as NCHRP Report 658: *Guidebook on Risk Analysis Tools and Management Practices to Control Transportation Project Costs*. Using the risk strategies outlined in NCHRP Report 574, this guidebook provides a systematic process to apply risk analysis tools and management practices to help state highway agencies control project cost growth.

“Highway design and construction projects are some of the most technically complex tasks in the world and are coupled with many uncertainties,” Molenaar said. “I compare them to medical procedures. So why do we try to put an estimate to that complexity using deterministic methods when so many things can go wrong? It’s not that common yet to do range estimating, but we hope to change that. Today, I want to inspire you to go back home and use this guidebook in your office.”

He went on to explain that it is critically important to separate the base estimate from contingency—those things we know and those we do not know—that could come back and hurt the budget. “[DOTs] are not in a good spot to say deterministically three or four years out what a project will cost.” He cited a study by Danish scholar Bent Flyvbjerg that looked at public projects over the last 70 years and found that 9 out of 10 times public projects are underestimated. In the study, titled “Underestimating Costs in Public Works Projects: Error or Lie?” Flyvbjerg essentially asks if engineers are purposely underestimating projects and lying to the public. “I don’t believe that

engineers are inherently liars...I think we work in an extremely complex world and we’re just overly optimistic,” Molenaar said.

He next illustrated what he called “refinement of a cost estimate”—what’s it going to cost and how can we estimate it over time—showing a “reverse trumpet of accuracy.” He explained: “In the planning phase, the range is really large. As the project moves forward...costs become more certain. We can get to our final cost after everything is complete, usually a few years later, and that’s based on how many risks actually occurred or didn’t.”

The fundamental question the guide addresses is how to estimate contingency. “We borrowed from the risk management concept and apply the same steps to estimating contingency and managing and controlling costs,” Molenaar explained. “The process is scalable based on project complexity and adaptable to project development phases.”

Molenaar then presented some terminology definitions and explained the subtle difference between risk and uncertainty. “When we talk about risks, we’re talking about events or things that can go wrong or that can go right; uncertainty is a small variance in planning. With risk identification, we’re looking for things that might occur that could change the costs and schedule...we want to find all of the things that could go wrong and then separate those into definable risks and opportunities that don’t overlap.” Report 658 combines different risk identification checklists [from various DOTs/agencies] to assist with this process. “I also encourage you to create your own checklists,” Molenaar contin-

ued. “But don’t start your risk analysis with a checklist; start with brainstorming, and then before you’re done, review the checklist to make sure you didn’t miss something.”

The risk assessment and analysis process involves looking at risk frequency and severity, or probability and impact, he said. “We can multiply frequency by severity to get a set of ranked risks or quantified risks for inclusion in a risk register. We can also come up with an expected value for contingency.”

He provided a brief overview of the probability-impact tool—or risk matrix—that is described in detail in Report 658. This qualitative assessment tool enables estimators to look at risks and come up with the likelihood, or unlikelihood, of encountering a specific risk. “We want to get a quick feel for things, multiply them together, and see where they fall on the chart [risk matrix]. If we have a lot of likely risks, we better include more contingency in our estimate.”

Molenaar then talked about three quantitative risk assessment tools from the guidance—expected value methods, three-point estimate methods, and the Monte Carlo simulation—which combine simple spreadsheets tools (e.g., Micro-

soft® Excel) and software modeling tools (e.g., Oracle Crystal Ball and Palisade @RISK).

According to Molenaar, some of the most difficult things to model are interdependencies and correlations. “If we have the risk of steel prices and cement prices changing—are they independent or are they correlated? Modeling or analysis that looks at individual risks and correlates them requires a lot of expertise. FHWA has some resources available or you could hire a consultant with this expertise; some DOTs even have in-house experts. The tools are out there, and you can learn to do this type of analysis.”

Molenaar summarized the report’s conclusions, noting that successful risk analysis should communicate cost uncertainty in project estimates using ranges and/or explicit contingency amounts. When conveying estimate information to legislators or the public, he reminded participants, the simplest representations usually work best. “Don’t make things too elaborate or too detailed; that doesn’t help people at all. While your analysis may be supported by a complex and probabilistically sophisticated model, it’s of little value if it is overly complicated.”

Tools for Measuring Risk



Jack Young



Terry Berends



Craig Actis



Raymond Mabey

Speakers: Jack Young, California Department of Transportation (Caltrans); Terry Berends, Washington State DOT; Craig Actis, FHWA; Raymond Mabey, Oregon DOT

Probabilistic Cost Estimating Using Crystal Ball Software

Jack Young from the California Department of Transportation (Caltrans) was up next to review his agency's use of Oracle Crystal Ball, a spreadsheet-based risk modeling program. Caltrans uses Crystal Ball to more accurately demonstrate the likelihood or unlikelihood of various potential risk factors, Young explained. "Traditional spreadsheet analysis often fails at this because it uses a single value, such as the average, to represent uncertain or variable inputs," he said. "The results of this type of analysis are static or deterministic and most likely will be unrepresentative of the range of possible outcomes. Cost estimates, however, are not static or deterministic. They are forecasts with a range of possible outcomes. Understanding the implications of these ranges leads to more accurate decisions."

Crystal Ball enables spreadsheet applications, such as Microsoft® Excel in the case of Caltrans, to become a predictable analysis tool rather than just a data organizer, he continued. "Crystal Ball uses ranges as inputs and generates thousands of outcomes with associated certainty. The results are easy to analyze and communicate to others. Clear communication is especially important between cost estimators and project managers."

In its Crystal Ball simulations, Caltrans uses three basic assumption curves ranging from more realistic/less conservative (normal distribution) to less realistic/more conservative (uniform distribution) with triangular distribution somewhere in between. "There are at least 40 or 50 different curves you can use in Crystal Ball to reflect your model," Young explained. "And if you have more than 15 input points, you can create your own curve."

He provided an example of how Crystal Ball can be used to create a probabilistic structure cost estimate by first showing an input example (planning-level estimate) and the resulting Crystal Ball output. The process begins by applying probability curves to a historical data set. Next, estimators build a model identifying potential threats and opportunities. They can simulate project bidding 10,000 times using Monte Carlo Simulation to then develop a probabilistic forecast including a range of likely final costs with associated confidence levels. The final step is a sensitivity analysis to determine the largest contributors to cost variance. "At this point, you can go back and look at the model and tune it up a bit more," Young said.

Probabilistic cost estimating provides several benefits over other estimating methods. For one, Young said, forecast results reveal the full range of costs and the probability of possible outcomes. In addition, the sensitivity analysis identifies which inputs drive most of the output variation, or threats and opportunities. "Crystal Ball is a user-friendly program with the potential to reduce cost estimate contingencies," he said adding, "It's also a transparent and defensible back-up for cost estimate certification."

Cost Estimate Validation Process

"Like everyone else, one of the main reasons we use risk-based estimating is to improve our chances of delivering projects on time and within budgets," Terry Berends of the Washington State DOT (WSDOT), reported. "As important, though, we want to keep our decision makers from being surprised by things such as significant cost increases or project schedule delays."

WSDOT began work developing a cost estimate validation process (CEVP®) in 2002, with the goal of improving project management by using better methods of validating and communicating the probable cost and schedule of projects. Initially, this involved developing policy and guidance and then creating a self-modeling spreadsheet tool that allows project managers to do risk-based estimating themselves or within their project office. WSDOT also created an online project risk management guide, and most recently, has implemented a risk reserve budgeting policy. “We’re trying to document our estimates better, and in the future, we want to develop project management certification on risk-based estimating,” Berends said.

He then reviewed some elements WSDOT found necessary for implementing risk-based estimating. “You really need support from the executive management and you need effective estimating and scheduling programs,” Berends said. He further recommended using simple, understandable, and scalable modeling tools. “Our self-modeling tool enables project managers to see various inputs and run ‘what if’ scenarios. The output includes simple one-pagers and risk registers...a modeling tool should help project managers deliver their projects, not be a burden for them,” he added.

Berends contends that effective project management requires good risk management. “When we started using risk-based estimating, our projects were funded at the 90 percent confidence level,” he explained. This generous budget minimized the incentive of good risk management and allowed many “desired but not required things” to creep into projects. WSDOT’s risk reserve budgeting process addresses this issue. “We’ve lowered the total budget figure to the 60 percent confidence level, which is strongly recommended if using post-mitigated results.”

In project budgets with risk reserves,

the project manager is expected to manage the project to the estimated base cost, Berends continued. “Our experience shows that typically the base cost estimate falls in the 25 percent to 40 percent confidence level,” he said. The risk reserve is set in a separate budget and must be actively managed; as risks are retired, the amount is adjusted.

Documentation is also critical. “We were getting into overruns, but there was no documentation to tell the story of what happened on the project. Now, if we exceed the risk reserve, we have a paper trail telling the story. We can present this to the legislature if we need to ask for additional funds.”

Berends pointed out that while risk reserve budgeting “is the way to go,” it is not a silver bullet. “The risk reserve is not intended to cover everything,” he explained. “For example, we had [an unknown problem occur] that cost \$100 million [to remedy] but had a probability of occurring of 2 percent. You can’t budget for all high-impact, low-probability issues.”

Berends then discussed a few of the benefits WSDOT has seen since implementing its CEVP. Risk-based estimating is a better use of funds and facilitates the use of estimate ranges, he noted. It also provides tighter scope control as well as improved consistency, transparency, documentation, and tracking. All of this has enabled WSDOT to increase public and legislative confidence. “We can better educate the public and legislature about the challenges that could be encountered and provide a better overall understanding of the project to everyone.”

For more information, view the online project risk management guide at: <http://www.wsdot.wa.gov/publications/fulltext/cevp/ProjectRiskManagement.pdf>.

FHWA Risk-Based Cost Estimate Reviews

FHWA's Craig Actis was next up and provided an overview of why FHWA is involved with reviews and cost estimating. "One reason is because SAFETEA-LU (Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users) required us to do so," he said. Actis further explained that because cost estimates [from state transportation agencies] had not been accurate, Congress mandated FHWA to review cost estimates of major projects. For example, financial plans for projects over \$500 million require concurrence from FHWA headquarters. And while financial plans are required for projects ranging from \$100 to \$500 million, plan review is at the FHWA division's discretion.

The objective of an FHWA cost estimate review, Actis continued, is to conduct an unbiased risk-based review to verify the accuracy and reasonableness of the total cost estimate to complete the project and to develop a probability range for the cost estimate that represents the project's current stage of design. Reasonable assumptions, he explained, can be derived only from risk-based analysis. "The key here is that we want to see a range for the cost estimate," he said. "Ultimately, the long-term goal is to transfer the technology of our risk-based cost estimating to DOTs so they can do their own reviews in the future." He pointed to WSDOT, which is already doing its own reviews, and to Caltrans, which is not far behind.

FHWA uses Oracle Crystal Ball software to analyze financial plans submitted by DOTs. The reviews are based on estimates from the project team in advance, with revisions made during the review, Actis said. "We rely on input from subject matter experts...FHWA does not verify quantities and unit prices."

Actis went through some of the key principles on which FHWA bases its

reviews. For example, he explained, the process must be transparent and the estimates should include all project costs including NEPA work, design, right-of-way, public outreach, project management, and construction. "These costs should be expressed in the year of expenditure dollars and assigned a realistic inflation rate of about 3 or 4 percent per year," he said. "Use the best information available and document assumptions and key changes. It's also important to account for risk and uncertainty and to get the right people involved in developing the estimate."

Actis next discussed the components of cost uncertainty. "Addressing this uncertainty usually involves conducting risk analysis prior to construction," he said. "Use risk analysis to derive contingency values and then report the results as ranges," he suggested.

He pointed out the importance of capturing soft costs, sometimes called design allowance or design contingency. "Often there are a lot of small items like guardrail and striping that are included in contingency but also included with other unknown unknowns, and it gets difficult to place a risk on those items." Preliminary or design engineering costs should also be recognized. "For most public agencies, preliminary engineering costs reflect only direct charges to design the project by engineering staff." Other soft costs to capture in estimates include construction contingency (money for change orders or unforeseen events) and construction engineering costs (money that pays for contract administration and may include office overhead). "I've seen this vary greatly around the country depending mostly on the accounting system used," Actis said.

He outlined several elements FHWA looks for when reviewing cost estimates. One consideration is whether or not an experienced estimator has been involved in developing the estimate; another is whether or not the estimate has been

reviewed by subject matter experts. Reviewers also check that all major items are included and risk allocated. A final check is made to see that soft costs are accounted for and that the estimate is 100 percent complete.

“We’ve found that contingency is probably the biggest variation driver in our cost estimating,” Actis explained. This is due to inconsistent application of contingencies and use of a percentage without much thought on what it includes. “It’s critical to document assumptions and your reasoning of what is included in the contingency.” He added too that there seems to be an inconsistent application throughout DOTs of what is included in inflation and escalation figures. For example, are the consumer price index (CPI) and the producer price index (PPI) included? Are market conditions, number of bidders, short-term material, and labor prices included? “We recommend that DOTs keep a cost index for historical trends and that they document the assumptions. It’s also important to keep the estimate updated, especially if the market and environment are changing fast.”

For more information on FHWA cost estimating, visit the FHWA Innovative Program Delivery Office website at: www.fhwa.dot.gov/ipd/project_delivery/index.htm and the CPM SharePoint Classroom website at: <http://one.dot.gov/fhwa/CPMDSS/FECPM/CE/default.aspx>.

Oregon’s Cost Estimating Process

Next, bringing another state perspective, Raymond Mabey of the Oregon DOT (ODOT) Office of Project Letting outlined his agency’s current cost estimating process. ODOT estimates are created by a project team, he explained, after which a central review is performed. “We are moving into using project charts and are trying to get some controls around scope and purpose. We use a cost estimate validation process (CEVP) on some projects and have been using anticipated

items to help us manage risk.”

Mabey reported that the push for ODOT to perform cost-risk analysis stemmed from so many bids coming in high. There had been a 30 percent rise in material costs from 2003 to 2006 and a 70 percent rise in these costs between 2003 and 2008, he explained. “We used cost-risk analysis as a tool for planning and cost management. This allowed us to actively manage risk drivers and proactively respond to problems.”

In one project (Sandy River bridge), for example, initial analysis indicated a high cost for a concrete bridge due to the amount needed for footings. “Through a cost-risk analysis, we determined that steel was a less expensive alternative to concrete, so we redesigned the bridge using steel...bids came in much lower than originally estimated.”

ODOT uses a four-step risk analysis process through which a variety of risk causes and impacts are identified including pricing uncertainty, industry capacity, project location, and timing—all issues that can cause budget elements to deviate from the estimate. ODOT’s cost validation process involves reviewing the cost estimate, identifying specific problems such as missing or misidentified items, creating a cost-risk model using risk analysis software, and developing cost ranges on each line item. “We also ask for input from engineers regarding unique technical issues that would affect cost as well as information the engineers may know but that is not apparent by simply looking at the cost data alone,” he said. The output of this analysis process results in a tornado diagram that identifies the highest risk items in the project. “We see tangible benefits from these efforts,” he reported. “The difference between engineering cost estimates and construction bids [in one particular project] was drastically reduced from a differential of more than 30 percent to 7 percent.”

Other Agency Experiences



Paul Judd



Greg Davis



Lesly Tribelhorn

Speakers: Paul Judd, Regional Transportation Commission of Southern Nevada; Greg Davis, Florida Department of Transportation; Lesly Tribelhorn, Montana DOT

Regional Transportation Commission of Southern Nevada

Paul Judd of the Regional Transportation Commission of Southern Nevada (RTC) discussed risk analysis from his agency's perspective. He first described the RTC as a unique organization in that it is both a transit authority and transportation-planning agency. "We have three major functions," Judd explained. "We provide mass transit, serve as the region's metropolitan planning organization (MPO), and administer the Freeway and Arterial System of Transportation (FAST)." FAST, he noted, is one of the first truly integrated intelligent transportation system (ITS) organizations in the country and is designed to both monitor and control traffic. The RTC is funded through a variety of revenue streams including money from FHWA, the Federal Transit Administration, and sales and motor vehicle fuel taxes.

Judd described the process by which the RTC selects projects, pointing out that first, the agency receives funding allocation. Next, each of the member entities that make up the RTC—which includes the City of Las Vegas, Clark County, Boulder City, the City of Mesquite, and the City of North Las Vegas—submits its project "wish list" including the estimated costs for each. "We then start the prioritizing phase, which involves a string of meetings I like to compare to a pre-fight stare down," Judd joked. "Nobody is willing to blink, and we soon find out that no one will ever blink because attitudes are all set in stone. Eventually, the horse trading begins. After the prioritizing phase, we prepare the regional transportation plan (RTP)."

In an RTC-sponsored survey of local practices, member entities were asked how they defined risk. In their responses,

member entities admitted that they didn't even account for risk let alone define it. When asked if they used contingency or risk-based analysis, survey responses showed that the level of detail used is generally cost per mile for linear features and lump sum for items like bridges and traffic signals. Risk is measured using a simple percentage for contingency. "This ranges from 10 percent in early planning up to 25 percent," he said. "We never use growth or year of expenditure factors."

Not surprisingly, Judd continued, the member entities also reported that final costs are generally higher than the planning cost estimates, usually require time extensions, and generate change orders exceeding 10 percent. "You could say we are typical," he said. According to the survey results, some of the major contributors to these issues include inaccurate planning cost estimates, scheduling inaccuracies, construction change orders, and project delays.

"Utilities also seem to be a common thread we can't seem to address," Judd said. "It presents a good opportunity for risk analysis. The challenge will be that before we buy into a risk assessment process that takes staff time and expertise we don't have, we have to be convinced that if it's broke it really needs fixing." Help is on the way, he concluded, in the form of a newly developed Nevada Department of Transportation (NDOT) Wizard cost estimating tool, which will facilitate development of reasonable and defensible cost estimate ranges.

Florida Department of Transportation

Greg Davis of the Florida Department of Transportation (FDOT) discussed some of the issues FDOT dealt with during a period of fluctuating construction costs. He then reviewed other issues particu-

larly concerning risk analysis.

He explained that in 2006 and 2007, FDOT saw an extreme escalation in costs due in part to a high global demand for material and competition for labor. Back in 2004 and 2005, Florida was hit by a record number of hurricanes, which further compounded the competition for resources. Fewer hurricanes since 2005 and the downturn in home construction have contributed to the falling prices seen lately. "In the past year, costs are dropping and bids are coming in 30 to 50 percent below estimates," he said. "In 2005 and 2006 we had 2.6 bids per contract. We're now up to 6.1 bids per contract, and this has helped further drop costs."

Davis reported also that contract awards in 2005 and 2006 were 21.1 percent over budget and the agency rejected 71 contracts during this time due to high bids. Today, approximately 25 percent of FDOT's budget is unused because contract bids are coming in so low. "We still reject some contracts now, but those rejects are due to problems other than high bids." From fiscal year 2007 to the present, FDOT has had a budget surplus. "We're working to identify additional projects to consume the excess budget," Davis said.

He next reviewed several strategies FDOT deployed to mitigate past cost-increase challenges. In February 2006, the agency sponsored a cost-increase summit with approximately 200 staff, key partners, and stakeholders. The conference theme was "Commitments Made Are Commitments Kept." "During that time, we had a lot of issues with projects being delayed because of funding, and we wanted to strengthen our commitment to delivering those projects," Davis said.

Some of the strategies that came out of that summit included refining the project scoping process and reviewing the awards criteria to ensure that the right contracts are rejected. "We also got into flexible design, specifically, bid options, which

provides the means to reduce a project scope of work to fit within the department's budget. When a contract is let, it's understood upfront that if there's not enough money in the budget to fund a project, we can reduce the scope of work. We have it in priority order what type of work can be reduced. We also have alternate scopes that we can pick from to fit the budget."

FDOT now uses a maximum budget specification, meaning bids above a maximum dollar amount are disregarded. "The maximum budget is not the official estimate, it's just the maximum amount of money we can expend on that contract," Davis explained. "In 2006 and 2007 we had 16 contracts let with that particular specification, with only one contract not receiving any bids. This was during the time when bids were coming in high on regular contracts, but contracts with this specification were coming in about 16 percent below that maximum budget amount. We averaged about four bidders per contract compared to about 2.5 on our other contracts. In 2007 and 2008, we had similar results. We let 17 contracts with the maximum budget specification, and all of them received bids about 14 percent below the maximum budget amount and had about five bids per contract."

In addition to the summit, FDOT conducted an internal cost estimate study geared at improving the cost estimating processes and tracking of project cost changes. Recommendations from that study include the need to document and approve scope of work and cost estimates, the need for better scope of work and cost estimate communication, and the need to create a more formal process for handling requests from outside groups for added work to a project. "Another initiative we took on was revamping our construction cost performance measures and developing an estimates report tracking system (ERTS) to support these per-

formance measures. This system contains five years' worth of data now, with the data refreshed daily," he said.

In a more recent initiative, Davis explained, "We set up a five-person 'SWAT' cost risk analysis (CRA) team to develop, implement, and improve FDOT's cost risk analysis process." The team's mission is to "manage/control the quality of construction cost and schedule estimates to ensure they are reasonable, defensible and reliable." Also, Davis reviewed the vision, goals, and objectives of the CRA team. The team is currently working to identify the projects requiring risk analysis and is reviewing various risk analysis software (e.g., Oracle Crystal Ball, Primavera Pertmaster, Palisade Corporation's @RISK). "Back in June, we had a consultant visit all of our districts to talk about the risk assessment/analysis process; it was very well received, and I think we have a good start to getting this implemented."

Montana DOT

Lesly Tribelhorn of the Montana DOT (MDT) next provided a small-program perspective. "We don't have mega projects, but we do still deal with risk management even at our small level." She offered some "quick facts" on MDT's program size, noting that it's mostly federal-aid. "We don't have much of a state program. The average project award is \$2.7 million, and the smallest project let in the past eight years was \$11,000. The largest was \$29 million. Most of our projects are around \$2 million with reconstructs up around \$6 million."

Tribelhorn then described MDT's cost estimating process and noted that it is working well for the most part. "Our project designers do most of the planning estimates, because our planners really don't want to," she said. "Like everyone else, we saw prices going up starting around 2005, and we weren't keeping up with inflation. In the last two years,

we've been about 11 percent below [inflation], and we do chase the market. We follow what's going on and try to adjust our prices so we stay pretty much at 11 percent."

"We've had a one-person cost estimating section for the past two years, which has been great," Tribelhorn said. "He's been able to focus on the estimating and get more in depth than I ever could...he works on engineers' estimates more than anything else."

MDT does not formally address risk at the planning level at all, she continued. "It may be included in a nomination cost and is supposed to be according to our cost estimating guidelines, but it's never documented and rarely ever included in the cost estimate. We add contingencies at the design level using a bottom-line percent and a sliding scale, but again, it's rare to see any documentation. The contingency covers risk and design allowances. We do not include contingency in the engineer's estimate but rather, we adjust items for risk and other things such as scale of economy."

MDT's current estimating guidelines contain a table of contingency and risk factors to consider when reviewing a project the first time. These include schedule time, project setting, availability of materials and contractors, project size, traffic control and railroad utility issues, environmental and geotechnical issues, potential for poor soil conditions, and unknown risk or potential change orders. MDT's current guidelines for factoring in contingencies include percentage ranges for various items. "They are fairly low," she noted. "For example, alignment and grade are factored at 10 to 25 percent, scope of work at 10 to 20 percent, plan-in-hand at 5 to 10 percent, and final plans at 0 to 5 percent."

As part of AASHTO's Technical Committee on Cost Estimating, Tribelhorn said she has seen what other states are doing with regard to risk management

and felt the time was right to help move MDT in a similar direction. She researched best practices of other states and reviewed NCHRP Report 574 looking for strategies that could add value to MDT's program without straining the agency's limited resources. "I ended up using the information from WSDOT and modified it to our needs," she said. In developing the risk management guidelines for MDT, Tribelhorn focused on risk documentation, assessment, and management. She's also proposing to still use contingency at the planning stage but hopes to refine the process a bit more. "As we get into design, we will start do simplified risk analysis...we'll continue to use design allowances and separate them from risk contingencies."

MDT incorporated WSDOT's spreadsheet-based risk management plan. "The ability to begin filling this out with identified risk at the planning stage and then pass that document up to design is really helpful. We can use the plan to continue identifying risk at various field reviews and milestones," Tribelhorn said.

Like WSDOT, MDT's risk analysis for projects less than \$10 million can be informal and involves a design manager and a risk management plan (RMP); these make up more than 90 percent of MDT's projects. For projects between \$10 million and \$25 million, risk analysis is still informal but involves more design team members and use of the RMP. Finally, projects more than \$25 million, less than 1 percent of MDT projects, require a more formal risk analysis involving a modified cost risk analysis (CRA).

"It's not worth it for us to run Monte

Carlo analysis," Tribelhorn pointed out. "Our risk analysis is essentially qualitative, which is easy to understand and requires less training and less time. Our focus is now on managing risks back at the planning stage, and each time we have a milestone, retire what needs to be retired, and add new ones as we need to."

Among the challenges Tribelhorn faces in implementing a new RMP is having to convince staff members that their additional duties will actually benefit them. Another challenge will be getting everyone to see risk as an opportunity, not just a threat. "I'll need to get acceptance for this new direction from management," she explained. "This hasn't been a directive from the top down; it's been an idea that I'm trying to present both up and down, and it will take time."

Tribelhorn plans to hold a small workshop with all of the "big players" to report back what she's learned at this workshop. As she moves forward with the RMP, she aims to keep the process simple, assess how it's working, and adjust the process as needed. For more information, visit: www.mdt.mt.gov.

Panel Discussions

Following the presentations, workshop attendees had the chance to ask questions of each speaker, and of other audience members, through two panel-type discussions. These question-and-answer sessions provided an opportunity for participants to interact with each other, ask for more detail on a specific presentation or topic, and share their own insights on the subjects being discussed.

Summary of Priority Strategy Action Plans

Large Group Brainstorming: Research and Actions Needed (Facilitated Discussion)

On Friday, workshop attendees spent the morning discussing what types of future initiatives are necessary to support cost estimating and cost management implementation. Moderator Gina Baas, with CTS, asked the group to generate and prioritize a list of strategies that could be used to develop action plans for moving these initiatives forward. Their ideas are summarized on the following pages.

Group 1

Priority Strategy 1

- Theme Area: Organizational Integration
- Strategy (title and brief description): National recommendation to DOTs for standardized cost management/estimating (CM/CE) strategies
- Desired Products/Outcomes: DOT formulation and adoption of CM/CE strategies
- Action Steps:
 - Provide the increased value/benefits of incorporating CM/CE strategies within an organization in an executive summary format
- Suggested Roles (AASHTO, FHWA, TRB, Others):
 - Lead: Appropriate AASHTO Subcommittee(s)

Priority Strategy 2

- Theme Area: Organizational Integration
- Strategy (title and brief description): Identify the value, to all areas of DOT organization, of implementing CM/CE strategies
- Desired Products/Outcomes: DOT grassroots support throughout the organization
- Action Steps:
 - Create a synthesis of the current body of knowledge and the value of implementing CM/CE strategies
 - Conduct knowledge exchange opportunities at national and state levels
- Suggested Roles (AASHTO, FHWA, TRB, Others):
 - Lead: Appropriate AASHTO Subcommittee(s); DOT to implement appropriate knowledge exchange opportunities

Priority Strategy 3

- Theme Area: Project Management
- Strategy (title and brief description): Project manager (PM) development. Broaden and strengthen project manager skills with an emphasis on risk management
- Desired Products/Outcomes: Better-informed/trained PM resulting in improved cost estimates, setting early project budgets closer to final project costs, responding to cost estimates resulting from identified risks. Foundation of how various functional areas communicate with each other, speaking the same language
- Action Steps: Look at PMI training curriculum, PMP accreditation. Coordinated national risk training (TCCC and Washington DOT, Caltrans). Coordination with established organizations, professional societies, private industry
- Suggested Roles (AASHTO, FHWA, TRB, Others):
 - Lead: AASHTO to lead the building of national standard (Committee on Project Delivery), SCOP, SCOH/TCCE

Priority Strategy 4

- Theme Area: Project Management
- Strategy (title and brief description): Front-end project planning. Define the scope and delivery approach of the project to establish the baseline cost estimate
- Desired Products/Outcomes: Use project management concepts to establish the project definition to establish the baseline cost estimate. Minimize and better communicate changes made to the baseline estimate throughout the project development
- Action Steps: Advancing the 574 Guidebook process and tools to establish a baseline cost estimate through peer exchange and workshops. Highlighting agencies with established cost estimating manuals. Incorporating other initiatives such as Complete Streets and Context Sensitive Solutions and involving internal and external stakeholders
- Suggested Roles (AASHTO, FHWA, TRB, Others):
 - Lead: FHWA through AASHTO to lead the workshop and peer exchange (SCOP, SCOH/TCCE)

Group 2

Priority Strategy 1

- Theme Area: Performance Measures and Performance Management
- Strategy (title and brief description): Compare forecasted total project cost to actual costs
- Desired Products/Outcomes: Report to show baseline compared to final costs, or costs at any stage. Scalable performance measures
- Action Steps: Collecting data, analyzing data over time. Develop common framework
- Suggested Roles (AASHTO, FHWA, TRB, Others):
 - Lead: NCHRP, WSDOT, FHWA project delivery team and resource center, and AASHTO

Priority Strategy 2

- Theme Area: Performance Measures and Performance Management
- Strategy (title and brief description): Define performance measures for project/program estimates. Establish cost estimating practices, including cost and risk management
- Desired Products/Outcomes: A group of performance measures for the states to choose from
- Action Steps: NCHRP synthesis to assess the state of the practice, identify gaps, document benefits, recommend new measures, compare and recommend for use and application
- Suggested Roles (AASHTO, FHWA, TRB, Others): AASHTO Subcommittee on Performance Measures, Coordinate with TCCE

Priority Strategy 3

- Theme Area: Performance Measures and Performance Management
- Strategy (title and brief description): Document how states are customizing various cost estimating tools and guidance
- Desired Products/Outcomes:
 - A synthesis of practice: interview states using customized estimating tools from other states

- How states have taken WSDOT's CRA process and tools and adopted for use
- Caltrans use of Crystal Ball
- Another state using @RISK and a customized spreadsheet
- Etc.
- Document the customization and the reason why
 - Can build off of recent TCCE survey
- Action Steps:
 - NCHRP synthesis of practice
 - Can build off of recent TCCE survey
- Suggested Roles (AASHTO, FHWA, TRB, Others): AASHTO SCOP, NCHRP 8-36

Priority Strategy 4

- Theme Area: Tools and Resources
- Strategy (title and brief description): Best practices: What is being used, by whom, and what are their results
- Desired Products/Outcomes: State of practice that identifies best practices and appropriate level of contingencies. It should identify appropriate tools for each stage or size of estimate and could compare current tools such as the risk analysis software available and being used, including spreadsheets
- Action Steps: Research to accomplish above. Establish a team consisting of some DOTs and academic researchers
- Suggested Roles (AASHTO, FHWA, TRB, Others):
 - Lead: Mn/DOT, Nevada DOT, WSDOT

Priority Strategy 5

- Theme Area: Tools and Resources
- Strategy (title and brief description): Establish a national forum on cost estimating fundamentals and risk analysis
 - Basic training fundamentals in cost estimating and risk analysis and risk management
- Desired Products/Outcomes:
 - An online social network that provides forums for peer-to-peer exchange of ideas and solutions
 - 24-hour interactive classroom providing discussion forums, access to training materials, surveys, and useful links
- Action Steps:
 - Gain support from TCCE, AASHTO, FHWA
- Suggested Roles (AASHTO, FHWA, TRB, Others):
 - TCCE could host and maintain the forum
 - Academics, States, FHWA

Group 3

Priority Strategy 1

- Theme Area: Communication
- Strategy (title and brief description): Communicating the benefits of risk management to transportation stakeholders. Tips and techniques for communicating risk and uncertainty with legislature, public, and peers
- Desired Products/Outcomes: Simple and straightforward guidance in the form of summary documents, training, or webinars. This guidance should be geared toward

- public involvement personnel who will be communicating risks to stakeholders.
- Action Steps: Identify appropriate funding mechanism for this short-term study; identify appropriate public information partners (non-engineers)
- Suggested Roles (AASHTO, FHWA, TRB, Others):
 - Lead: Standing Committee on Planning

Priority Strategy 2

- Theme Area: Risk Assessment and Risk Management
- Strategy (title and brief description): Strategies and tools for program-level risk management. Addressing risk across multiple projects in order to optimize risk management across the entire program
- Desired Products/Outcomes: A guidebook that presents new methodologies for managing cost and schedule risk at a program level
- Action Steps: Develop a problem statement to submit to NCHRP for a long-term study option
- Suggested Roles (AASHTO, FHWA, TRB, Others):
 - Lead: TCCE champion this project with the Subcommittee on Design and Standing Committee on Highways. Mn/DOT or CTS champion this project with the Standing Committee on Planning

Priority Strategy 3

- Theme Area: Risk Assessment and Risk Management
- Strategy (title and brief description): Linking Risk Assessment with Risk Management. Document tools, methods, and techniques on linking risk assessment with risk management. For example, Pertmaster within Primavera is a schedule-based risk assessment tool rather than a statistical-based risk assessment tool which focuses primarily on cost. Need to take the statistical-based tools and link to a risk-based schedule. Incorporate the concept of risk reserve into the construction phase.
- Paul Judd (RTC Nevada); Terry Berends (WSDOT)
- Desired Products/Outcomes: Synthesis and/or state-of-the-practice document
- Action Steps: Develop a more concise problem statement and submit as part of an NCHRP project

Priority Strategy 4

- Theme Area: Other
- Strategy (title and brief description): Addressing CE/CM in an accelerated project delivery situation (environment). Document how CE/CM is affected by accelerated project delivery situations. Currently in an environment where projects need to be quickly delivered including short-term grants (ARRA/TIGER); fiscally constrained environments; private equity/PPP/design-build; specialized funding. How have states been successful in addressing CE/CM within this environment?
- Matt Hardy (AASHTO)
- Desired Products/Outcomes: Synthesis and state of the practice document case studies. Workshop disseminating information once complete
- Action Steps: Develop problem statement
- Suggested Roles (AASHTO, FHWA, TRB, Others):
 - Lead: AASHTO 08-36

Priority Strategy 5

- Theme Area: Other
- Strategy (title and brief description): Cost estimating and risk management tools for alternative contracting techniques. How is cost estimating and risk management addressed within alternative contracting techniques?
- Desired Products/Outcomes: Identify best practices related to:
 - Design/Build
 - CMAR (Construction Manager At Risk)
 - CMGC (GCCM)
 - Public Private Partnerships (private equity)
 - Research current industry best practices. Document describing case studies.
- Action Steps: Develop a problem statement. Determine if this is addressed within the AASHTO cost estimating guidebook

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