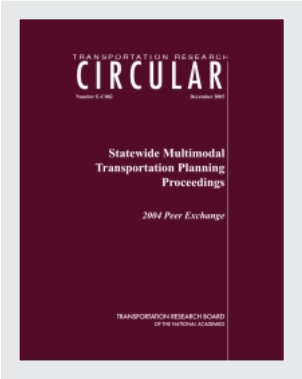

Statewide Multimodal Transportation Planning Proceedings: 2004 Peer Exchange

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2004 Peer Exchange

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Transportation Research Board
500 Fifth Street, NW
Washington, DC 20001
www.TRB.org

Ann Petty, Production Editor; Jackie Kearney, Proofreader; Jennifer J. Weeks, Layout

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Introduction

The Transportation Research Board (TRB) Committee on Statewide Multimodal Transportation Planning (ADA10) hosted a peer exchange immediately following the 2004 Joint Summer Meeting of the Planning, Economics, Environmental, Finance, Freight, and Management Committees. The meeting was held in Park City, Utah, on July 27–28, 2004. The peer exchange focused on cost estimating for transportation planning and incorporating safety into the transportation planning process. The peer exchange was sponsored by the Federal Highway Administration (FHWA). The peer exchange was jointly organized by TRB representatives of the American Association of State and Highway Transportation Officials (AASHTO) Standing Committee on Planning, the Standing Committee on Highways, the Subcommittee on Asset Management, and the FHWA.

The primary purpose of the peer exchange was to facilitate an open exchange of information on experiences, concerns, and opportunities related to addressing both cost estimating and safety within the statewide and metropolitan transportation planning processes. A secondary purpose of the peer exchange was to identify a near-term action agenda for improving the state of the practice for addressing safety in transportation planning.

While the focus of the peer exchange was on statewide transportation planning, a metropolitan planning organization (MPO) representative participated in the peer exchange, and the state department of transportation (DOT) representatives provided observations from working with their MPO planning partners in regards to the two topics.

Peer Exchange Format

The peer exchange was held over two days. The first day of the peer exchange was dedicated to cost estimating, while the second day was dedicated to safety planning. Prior to the peer exchange, each participant received two sets of questions and the initial draft report from NCHRP Project 8-44 (Incorporating Safety into Long-Range Transportation Planning), in accordance with the work plan approved by that NCHRP project panel. One set of questions addressed each state's experiences with cost estimating in planning, while the second set of questions addressed each state's activities in relation to safety planning. Participants were asked to review the draft report prior to the exchange and prepare written responses to both sets of questions.

The first set of questions, which related to cost estimating, was as follows:

- What are the major issues you are facing regarding planning or programming cost estimates?
- Describe policies, procedures, techniques, and standards used in preparing planning and programming conceptual estimates. If these policies, procedures, techniques, and standards are documented (written), please provide a copy or a website location where we can obtain a copy.
- How do you ensure that conceptual estimates reflect all elements of project scope (e.g., related to design, construction administration, construction, right-of-way, environment, etc.) as defined at the time conceptual estimates are prepared?
- What types of historical data do you use as a basis for preparing conceptual estimates? How are these data adjusted for time (schedule), location, and other project specific conditions?
- How are contingency amounts incorporated into the estimate? Are contingency amounts based on total estimated cost, identified project risks, or some other variable?

The second set of questions, which related to addressing safety in transportation planning, was as follows:

- To what extent is the framework presented in the NCHRP 8-44 initial draft report relevant to what you are doing in addressing safety in your statewide or metropolitan transportation plan?
- What are the gaps between what you are doing and what this framework suggests?
- What are the barriers to implementing this framework?
- What lessons have you learned in addressing safety in your state transportation plan that may be useful to other states?

The first day of the peer exchange included a presentation by Stuart Anderson and Keith Molenaar regarding the research plan for NCHRP Project 8-49, Procedures for Cost Estimation and Management for Highway Projects During Planning, Programming, and Preconstruction. Following the presentation, Charlie Howard facilitated a roundtable discussion that included a review of each participant's responses to the introductory questions, and development of

suggestions for the NCHRP Project 8-49 research team on potential emphasis areas during the research effort.

The second day of the peer exchange began with a review of federal safety planning activities by Ken Leonard. Mike Meyer then presented an overview of the initial draft report for NCHRP Project 8-44 (Guidebook to Incorporating Safety into Transportation Planning and Decision Making). Following Meyer's presentation, Janet D'Ignazio facilitated a roundtable discussion that included a review of each participant's responses to the second set of introductory questions, identification of other challenges and needs related to addressing safety in transportation planning, and preparation of a list of actions for furthering the state of the practice.

The following sections provide an overview of the presentation and roundtable discussion during each of the two peer exchange elements. Written responses from the state DOT and MPO participants are included in Appendix A (for cost estimating) and Appendix B (for safety).

Current State Activities

The peer exchange began with each state DOT representative providing an overview of major transportation planning activities, initiatives, and challenges within their state. Major points raised by each participant are as follows:

- Washington State DOT (WSDOT) is in the process of updating its statewide transportation plan (SWTP).
- At the Vermont Agency of Transportation (VAOT), cross-border planning is currently a key issue. The VAOT has participated in the Northeastern Freight Study and a Cross-Border Freight Study.
- Pennsylvania DOT (PennDOT) has recently started updating its SWTP.
- Ohio DOT (ODOT) recently completed an update to their SWTP; freight and quantitative objectives were key considerations in the update process.
- Utah DOT (UDOT) recently developed a local planning guide that provides UDOT's assessment of transportation conditions in local areas throughout the state. UDOT is finding that the guide provides a reasonable departure point for discussions between communities and the DOT, even if the communities disagree with content in the guide.
- Virginia DOT (VDOT) is about to begin preparation of a true multimodal SWTP that will include visioning and performance-based planning processes. A multiagency coordination committee has also been developed to suggest intermodal connections and multimodal projects for consideration in the DOT's programming processes. VDOT is also identifying "multimodal investment networks" throughout the state. These networks will provide a framework for prioritization, and projects within these networks are more heavily considered in the VDOT's evaluation processes.
- Michigan DOT (MDOT) is heavily focused on preparing an environmental document for a new international border crossing in the Detroit area; this activity has been challenging for MDOT since it requires the merging of distinct environmental processes from two countries. MDOT's asset management system is in the process of being expanded to the entire federal-aid highway system. MDOT now has consistent statewide criteria for pavement management and is currently developing a forecasting and evaluation tool for pavements. MDOT will begin preparing a new SWTP later in the year. On the topic of safety, MDOT has adopted the USDOT's safety goal, and they have fixed a nagging "churn" problem in their safety data.
- Texas DOT (TxDOT) is currently updating the SWTP, which is likely to be a policy plan. TxDOT has been attempting to streamline its funding categories and its process for distributing funds. SWTP work groups have been developing financially constrained 25-year project lists that, when combined with data from MPO plans, will provide information for a project-specific SWTP. Several new funding strategies are finding increased use in Texas. For example, every major project must now consider toll feasibility. Also, TxDOT is now allowed to borrow to assist with liquidity in its cash account.
- North Carolina DOT is ready to adopt a new SWTP, and there is an agency-wide effort on context-sensitive design.
- Minnesota DOT (MnDOT) recently adopted its first highway system operations plan. MnDOT's recently completed SWTP includes specific performance targets.

- Montana DOT (MDT) recently updated its SWTP and continues to institutionalize its performance programming process (PPP). MDT is using its new "HEAT" planning tool to assess macroeconomic benefits of potential investments. This assessment is much broader than user benefits (GDP, job growth, etc.); HEAT is designed to answer tough questions such as "is a project beneficial to the entire state as opposed to a limited set of users?" MDT will use HEAT at system, project planning, and project environmental levels, as well as to reassess its entire program. MDOT is also preparing a comprehensive safety plan and is assessing its cost-estimation practices.
- Florida DOT (FDOT) is continuing its process of integrating environmental and planning activities. FDOT is updating its SWTP, which will have a strong focus on intermodalism and economic development. FDOT continues implementation of its Strategic Intermodal System (SIS), which identifies the highest level intermodal and multimodal investment priorities in the state. SIS is being used to change FDOT's internal investment priorities. In the past, FDOT generally accepted MPO's priorities within the Statewide Transportation Improvement Program (STIP); however, STIP development is now more of an interactive process using SIS. FDOT is developing planning tools within SIS to assist with crossmodal prioritization. FDOT has identified over $100 million in near-term intermodal investment needs but continues to have a hard time conducting intermodal trade-off analysis to prioritize these needs.
- Wisconsin DOT (WisDOT) has been focusing on transportation planning needs in southeastern Wisconsin and on interacting with the MPOs in that region. WisDOT and the MPO are trying to better integrate environmental considerations into planning activities that occur prior to Environmental Impact Statement (EIS) preparation. The MPO cooperated with WisDOT to conduct an analysis of freeway reconstruction and expansion in Milwaukee, and WisDOT assisted the MPO in reaching an agreement with the governor to begin implementation of the recommended reconstruction strategy in the next budget cycle.
- Missouri DOT (MoDOT) is in the initial phases of updating its SWTP. The last SWTP focused on physical conditions and rail hubs, but the new one is likely to focus on safety, economic development, and congestion reduction. MoDOT has published a framework for conducting transportation planning throughout the state. The framework provides information on how everyone can become involved in each phase of planning and project development.
- California DOT (Caltrans) is also in the process of an SWTP update. California's SWTP is a policy plan by virtue of state law. SWTP activities are heavily oriented on public and stakeholder outreach. The economy, equity, and environment are major themes in the update process, and these themes have resonated with the new administration in California.

Cost Estimating for Transportation Planning

The purpose of the cost-estimating discussion was to help scope what the issue involves. The key objective of the discussion was to provide feedback to the NCHRP 8-49 research team on what should be done with the project and to help the peer group scope out additional issues that could be ripe for research.

PRESENTATION OF RESEARCH PLAN FOR NCHRP PROJECT 8-49

Stuart Anderson and Keith Molenaar led the presentation of the research plan for NCHRP Project 8-49. They pointed out that the main problem that has spurred interest in this research topic is the widely experienced phenomenon of cost escalation over the course of project development. They noted four issues that are frequently behind this problem:

- Difficulty in evaluating the quality and completeness of early project cost estimates;
- Difficulty in describing scope solutions for all issues early in project development;
- Difficulty in identifying major areas of variability and uncertainty in project scope and costs; and
- Difficulty in tracking the cost impact of scope development that occurs between major cost estimates.

The objective of NCHRP Project 8-49 is to develop a guidebook on highway cost-estimating management and project cost-estimating procedures aimed at achieving greater consistency and accuracy between long-range transportation planning (LRTP), priority programming, and preconstruction estimates. In conducting the research, the research team is looking at both estimating procedures and management of the estimates.

The researchers presented a framework, shown in Figure 1, which illustrated one view of the interaction between the elements that dictate the cost estimation needs: strategies, methods, and tools available for cost estimation; project development phases; and project complexity.

- Strategy. Provide consistent project estimates across different organizational units (e.g., districts).
- Method. Standardized typical sections are tied to historical unit costs as the basis for estimating project costs; user has to select the typical section and then select percentages to cover other costs such as maintenance of traffic.
- Tool. Computer software that automates the estimate of quantities and costs for different components of typical section; percentages for other costs are selected and total project estimated costs are generated.

The researchers then presented an overview of their work plan. Phase I, which includes five tasks, is being conducted through November 2005. Phase II, which includes the remaining five tasks, is scheduled to conclude in January 2006. The work tasks are

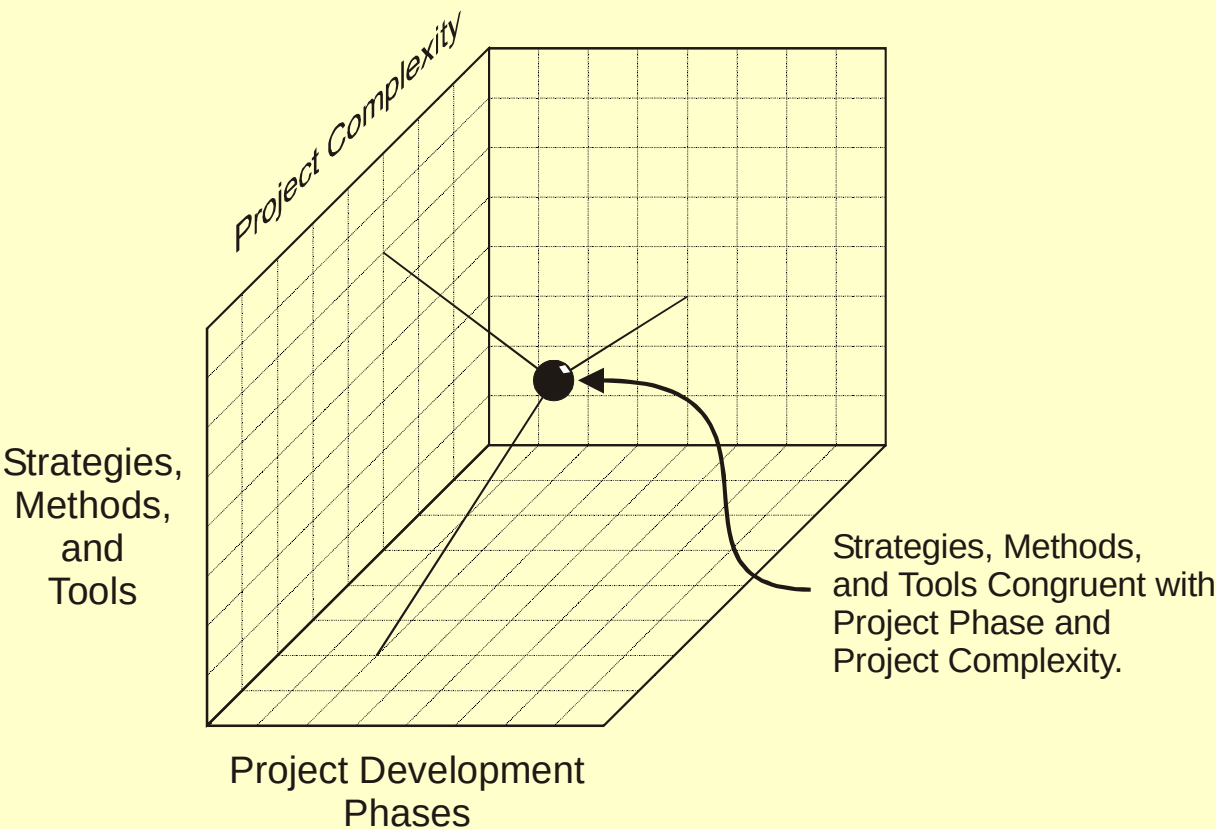

FIGURE 1 Conceptual Framework of Interaction between Cost Estimation Influences.

- Phase I Tasks
  - Task 1: Conduct state-of-practice review of cost management and estimating practices
  - Task 2: Develop critical review of current cost management and estimating practices
  - Task 3: Identify potential strategies, methods, and tools
  - Task 4: Prepare preliminary outline of guidebook
  - Task 5: Prepare interim report
- Phase II Tasks
  - Task 6: Develop and evaluate strategies, methods, and tools
  - Task 7: Present strategies, methods, and tools to industry
  - Task 8: Develop recommended strategies, methods, and tools
  - Task 9: Develop implementation plan
  - Task 10: Prepare guidebook and final report

The major product of the research effort will be a guidebook of strategies and practical techniques that integrate cost-estimation management and cost-estimation procedures. The guidebook will

- Address major causes of cost escalation,
- Consider requirements from planning to completion of plans specifications and estimate (PS&E), and
- Consider impact of project complexity.

The Phase I research work, which has already begun, includes a state-of-the-practice review conducted through agency surveys and interviews and a literature review. The researchers have discovered that there are general factors that lead to cost escalation whether a project a transportation oriented or not. There seems to be a lack of specific cost-estimating methods and tools in the transportation profession, which is a major contrast to practice in other areas (e.g., industrial construction).

Through its work, the research team has found a general segmentation of cost-estimating practices and thoughts in the following four time frames:

- From 13 to 25 years prior to project implementation, which tends to be affiliated with the planning phase;
- From 1 to 12 years prior to project implementation, which tends to be affiliated with the programming phase;
- From 4 to 8 years prior to project implementation, which tends to be affiliated with advanced planning and preliminary design; and
- The last 1 to 3 years prior to project implementation, which tends to be affiliated with final design.

The research team has conducted interviews with 15 state DOTs to date (California, Florida, Georgia, Illinois, Kentucky, Minnesota, Missouri, Nebraska, New York, North Carolina, Pennsylvania, Texas, Utah, Virginia, Washington), and others are planned. The interviews have addressed estimate preparation, estimate reviews, estimate communication (who approves estimates and how are they released), and cost estimating management (how to track changes and reconcile differences in estimates). The interviews have been a mixture of individual and group discussions, and have been conducted both on-site and over the phone. The research team used the interviews to identify both general unique approaches among the state DOTs to different cost-estimating problems and issues uncovered in the literature review. The interviews have also allowed the research team to better understand gaps in the state of the practice.

PARTICIPANT FEEDBACK ON COST-ESTIMATING CHALLENGES AND STRATEGIES

The research team asked the Peer Exchange participants to provide specific feedback on the major issues that planning practitioners face with cost estimation and how these issues might be overcome. The following lists some of the major cost-estimation issues raised in the discussion:

- The environmental process and mitigations are not fiscally constrained;
- Right-of-way quantities are difficult to estimate and costs are speculative;
- Utility costs can be difficult to estimate;
- Geotechnical problems are difficult to identify prior to final design or construction, or both, yet can create the need for costly project revisions;

- Historic preservation issues can be difficult to predict at the system and early project planning phases;
- Storm water requirements are changing, and historic experience may no longer offer a valid guide;
- Project costs to address the Americans with Disabilities Act, environmental justice, and context-sensitive design are difficult to anticipate during the planning phase;
- Costs are not inflated to year of expenditure;
- Scope change due to unforeseen events, project scope creep, and the tendency for a "Christmas tree" effect (i.e., attempts to add peripheral or unrelated items to a project that is nearing implementation);
- Purposeful underestimation;
- Sufficient staff resources not available or allocated to cost estimation efforts during planning; and
- Long time frames between planning and construction.

The following strategies for managing the cost-estimation process during system planning, project planning, and programming were mentioned in the discussion:

- Relate estimates and estimating techniques to the level of project complexity;
- Estimate project value to act as a limit to maximum appropriate cost for a project;
- Create disincentives for cost overruns (deprogramming, demoting, etc.) and incentives for getting projects done on budget;
- Make cost-management systems transparent to the public (e.g., quarterly reporting with detailed explanation of changes);
- Delay putting projects into the STIP until after rigorous scoping process is completed for the project;
- Identify major "red flags" or risk areas during initial planning;
- Communicate ranges generated by risk analysis at early planning stages and develop a hierarchy of cost-estimating nomenclature to describe the level of uncertainty;
- Price essential project requirements as a baseline cost and price any amenities separately;
- Improve coordination and communication between the SWTP/STIP program manager and the project manager;
- Educate planning partners about the purpose and accuracy of conceptual estimates;
- Manage project scoping so that the cost estimates remain in-line with the actual value of project benefits; and
- Aggressively preserve right-of-way (ROW) corridors in advance of construction.

ROUNDTABLE DISCUSSION ON STATE DOT EXPERIENCE WITH COST ESTIMATING FOR TRANSPORTATION PLANNING, PROGRAMMING, AND PRECONSTRUCTION

Following the presentation, Charlie Howard facilitated the peer exchange. Each participant was provided an opportunity to respond to the prompting questions that had been prepared by the research team and sent to participants prior to the exchange:

- What are the major issues you are facing regarding planning or programming cost estimates?
- Describe policies, procedures, techniques, and standards used in preparing planning and programming conceptual estimates. If these policies, procedures, techniques, and standards are documented (written), please provide a copy or a website location where we can obtain a copy.
- How do you ensure that conceptual estimates reflect all elements of project scope (e.g., related to design, construction administration, construction, right-of-way, environmental, etc.) as defined at the time conceptual estimates are prepared?
- What types of historical data do you use as a basis for preparing conceptual estimates? How are these data adjusted for time (schedule), location, and other project-specific conditions?
- How are contingency amounts incorporated into the estimate? Are contingency amounts based on total estimated cost, identified project risks, or some other variable?

Montana

Cost-estimation issues in Montana include projects in the STIP with rapidly changing costs that force the removal of other projects. This then changes the performance achievement of the entire program. Since MDT's SWTP is policy based, its cost constraint activities begin in the unfunded component of their work program. However, MDT faces continuing challenges in the constrained element of their program. Because NEPA is not cost constrained, and design engineers want to build projects, they often make promises that are not reasonable to get the project approved. MDT has found in recent years that costs for last-minute addition of items outside of the curb line can account for up to 20% of a project's total cost. Including a contingency in a project's cost estimate (10% is typical at MDT) can be a self-fulfilling prophecy; a lot of desires are circling around just waiting for a road project.

Projects that have an Environmental Assessment (EA) or Environmental Impact Statement (EIS) tend to have high cost increase risks. Categorical Exclusions (CEs) projects tend to have low cost risk and variability.

Michigan

MDOT has found that routine projects that are funded in 5-year increments (e.g., pavement overlays, bridge maintenance, etc.) have less risk and variability, and changes in cost estimates tend to be minor and can be absorbed in the overall program. MDOT underprograms by the amount of contingency in projects. The agency keeps contingency in cost estimates, but does not program this amount so that it avoids the automatic escalation that seems to occur. MDOT has been successful in addressing cost estimation on routine projects, with organizational changes implemented to help contain cost increases:

- Funding and implementation of routine projects has been decentralized; districts can deliver more projects if they control their own costs.
- MDOT now provides standardized guidance on contingency factors.

Minnesota

Typically, project managers are rewarded for getting the project to construction, not for cost containment. MnDOT also finds a risk distinction between routine projects and major capital investments. ROW costs are a big problem area for MnDOT, and the agency does not have management systems to track cost differences by geographic area. In both project development and programming, cost estimates are not revised until major changes have been made; therefore, they tend not to know about problems until they have become very big.

Florida

FDOT has a regional equity program that affects cost estimating. FDOT has developed an extensive set of internal documents and models for cost estimating, and a cost-estimating report is used in planning. FDOT develops all planning-level cost estimates for SIS projects, even those within MPO boundaries. There are three main risk areas for cost estimating in Florida:

- Right-of-way, since Florida is a highly urbanized state;
- Environmental mitigation (one reason for bringing environmental considerations into planning was to have better cost containment); and
- Cost creep due to project scope creep.

FDOT now allows local jurisdictions to deliver DOT projects with the idea that cost containment is easier at the local level. FDOT is also focusing on cost containment within the five-year element of their SWTP, because

- Florida is a growth management state, so infrastructure must be in place before development can occur. Programmed projects must be delivered on time or local development plans will be put in jeopardy.
- FDOT has very high levels of accountability with very public performance measurement; therefore, project delays affect performance achievement.
- There are strong regional equity concerns.
- Cost increases within the system preservation program have begun to affect FDOT's ability to deliver capacity projects.

Washington

Cost estimating has become a big issue in Washington in the past few years due to very public cost overruns at Sound Transit. There is a public perception that political pressure may have been brought to bear to understate Sound Transit's costs prior to the local election to approve and fund the system. At the same time, WSDOT was starting to develop megaprojects. Given public concern, several actions (both internal and external to WSDOT) were taken on the cost estimating front:

- WSDOT developed the Cost Estimation Validation Process (CVEP), which is a risk assessment process for individual projects to help develop realistic cost estimates. Projects are programmed at 90% confidence level (Monte Carlo simulation is used to develop the confidence

band). There has been public and media support for CVEP, but less support from local jurisdictions.

- A 2003 funding package that included a $0.05 gas tax increase contained a time line and budget for each project in the enabling legislation.
- Enabling legislation for the proposed regional transit investment district included accountability provisions that would have required any project with over 20% cost increase to go back to the public for a revote. However, this initiative was not passed.

WSDOT's SWTP is project specific with cost estimates provided for conceptual improvements. The agency's cost estimation tools need improvement for ROW and environmental components.

Missouri

MoDOT's cost estimating problems stem, in part, from a 1992 "promise" by the MoDOT Commissioner to deliver a long list of projects for $14 billion. However, $12 billion has been spent to date and only 25% of the projects on the list have been completed. Due in part to this issue, the legislature now requires very detailed tracking of project costs each year (part of an accountability initiative), and a detailed accounting must be provided of project cost changes that exceed 10%. MoDOT has also changed their planning and programming processes so that project scoping now brings projects up to the ROW phase where good cost estimates can generally be made. It is only after this phase that projects are added to the STIP. At MoDOT, district engineers are responsible for delivering a specific list of projects, so any cost overruns must be made up on other projects within the district. Cost escalation for ROW has not been a major problem to date, but it is starting to come up more frequently; the current STIP is the first one to include 3% annual cost escalation for ROW.

Wisconsin

In Wisconsin, the SWTP's major capital projects go through a rather extensive benefit–cost analysis. There is competition among regions of the state for these projects, which seems to encourage local jurisdictions to underestimate costs. WisDOT's reasons for project cost increases are similar to other states (environmental, context-sensitive design, etc.), and like other states, more diligence is required for big risky projects in Wisconsin. WisDOT's SWTP is prepared in real terms; therefore, normal inflation creates apparent price increases when a project goes to construction.

Vermont

VAOT does not have standard cost-estimating procedures across the agency; rather, each project manager has his or her own process. VAOT does not have uniform square footage costs for construction elements. There has been an up to 50% cost increase from planning to construction on VAOT's most difficult projects.

VAOT is considering variable local match requirements (similar to Maine) for local jurisdictions that want extra amenities on state projects; VAOT wants the local jurisdictions to pay for these amenities. In a spirited follow-on discussion, there was some disagreement as to how these additional amenities should be characterized. Many felt that decision makers and

elected officials need to be aware of the cost-estimating risk that amenities create; in the words of one participant: "Let's fully disclose the cost of doing business in today's world."

Ohio

ODOT tries to develop detailed cost estimates for big picture needs (safety, etc.) as part of system level planning at the state and MPO levels. ODOT categorizes projects as "minimal," "minor," and "major." Costs for minimal projects are not tracked individually, with the focus instead on delivering the entire program. Major projects go through a 14-step cost-estimation review process, and both minor and major projects need to have cost estimates updated monthly. ODOT also conducts a "red flag analysis" at the beginning of a project's planning phase to help identify potential cost-estimation risk areas. Many of Ohio's MPOs have resolutions that place a cap on the amount of federal and state funding available for each project, with local jurisdictions required to pay for any cost overruns. ODOT and many MPOs have also gotten more aggressive in delaying projects if they are not ready for construction or local money is not available for either the base cost or overruns.

Utah

UDOT is transitioning from a policy to a project-specific SWTP. Cost estimating is now a much bigger issue, and UDOT is considering value engineering or something similar to CEVP as a pre-STIP process. UDOT is also considering requiring that the NEPA process be completed before a project's construction phase is included in the STIP. ROW has become an area of key concern for UDOT, but dedicated funds for corridor preservation may help UDOT get control on this issue to some extent; UDOT also has a ROW asset management system. Context-sensitive design has not been a cost-estimating risk area in Utah to date, and each UDOT district has a lump-sum contingency fund for projects and that contingency fund can be flexed to other needs if it is not needed for projects.

Virginia

The major cost issues facing VDOT are credibility and budget; up until a few years ago, program revenues were significantly overestimated. VDOT is now using a "dashboard report" to show the budget and schedule status for construction projects. Experience in preparing the report has led to a current research project to assess why these problems are occurring. VDOT has a relatively new cost-estimating software in use, with project costs updated every 90 days. While VDOT includes project-specific costs in the 6-year STIP, there is no project-specific cost estimating conducted as part of the SWTP process—just a broad comparison of needs against revenues.

Incorporating Safety into Transportation Planning

REVIEW OF FEDERAL SAFETY PLANNING ACTIVITIES

Ken Leonard began the second day of the Peer Exchange with an overview of recent federal initiatives on the topic of safety conscious planning. The federal emphasis arose out of TEA-21, but many states were actively working on safety planning before that time through their SWTPs or the Governor's Office of Highway Safety. AASHTO has prepared a strategic highway safety plan, and several safety-related guidebooks have been published by both AASHTO and NCHRP. At the May 2004 AASHTO Standing Committee on Planning meeting in Charleston, South Carolina, participants reviewed Susan Herbel's book on safety conscious planning and participated in a peer exchange with Herbel.

PRESENTATION OF INITIAL DRAFT REPORT FOR NCHRP PROJECT 8-44

Following the introductory discussion, Michael Meyer presented an overview of the initial draft report from NCHRP Project 8-44. This presentation was made in accordance with the work plan approved by NCHRP Project Panel 8-44. Meyer began his presentation by noting that agencies have historically focused on geometric design and facility operations in their safety activities. More recently, however, efforts have increasingly focused on enforcement, education, and emergency services. Meyer used this background to point out that the scope of the guidebook is much broader than physical changes to the transportation system.

Safety is an important issue for planners and the transportation planning process for seven reasons:

- Travel safety is clearly an issue that can be affected by how the transportation system is designed, constructed, operated, and maintained.
- The costs associated with motor vehicle–related fatalities and vehicle crashes are large.
- Motor vehicle fatalities and crashes are a leading public health problem in the United States.
- For states and metropolitan areas struggling with congestion on freeways and other major roads, crashes represent a major source of congestion (referred to as "nonrecurring" congestion).
- Evidence from around the world (including the United States) suggests that crashes can be prevented.
- A comprehensive safety program includes a range of strategies and actions and involves many different agencies and groups.
- Safety has been identified by the U.S. Congress as a national issue that needs to be considered during the transportation planning process.

Meyer then presented a conceptual framework for undertaking transportation planning activities. Figure 2 presents this conceptual process, and the guidebook devotes space to

describing this planning process. An ability to integrate safety into planning presupposes that all participants have a common understanding of transportation planning. In this conceptual process, the initial education process of visioning and goals are key. Analysis and evaluation are separate processes, as shown in Figure 2, with analysis disaggregating a problem for consideration while evaluation reaggregates the disparate answers into a holistic view. In the framework, planning products include not only a plan document, but also policies, regulatory strategies, marketing, operational strategies, educational programs, partnerships, and many other products, including safety.

The planning framework in Figure 2 is the organizing mechanism for the remainder of the NCHRP 8-44 guidebook. The guidebook steps through a series of exercises that allows agencies to assess the degree to which safety considerations are integrated into their processes and then provides recommendations for improving these linkages. The relationship of these steps to the conceptual planning framework is illustrated in Figure 3. The guidebook includes the following "quick look" checklist to help an agency determine if its safety planning activities meet state-of-the-practice procedures:

- Does the vision statement for the planning process include safety?
- Are there at least one planning goal and at least two objectives related to safety?
- Are safety-related performance measures part of the set being used by the agency?
- Are safety-related data used in problem identification and for identifying potential solutions?
- Are safety-analysis tools used regularly to analyze the potential impacts of prospective strategies and actions?
- Do the evaluation criteria used for assessing the relative merits of different strategies and projects include safety issues?
- Do the products of the planning process include at least some actions that focus on transportation safety?
- To the extent that a prioritization scheme is used to develop a program of action for an agency, is safety one of the priority factors?
- Is there a systematic monitoring process that collects data on the safety-related characteristics of transportation system performance and feeds this information back into the planning and decision-making process?
- Are all of the key safety stakeholders involved in the planning process?

The assessment and recommendation exercises in the guidebook are organized by the major elements of the conceptual planning process:

- Vision,
- Goals, objectives, and performance measures,
- Data and analysis tools,
- Evaluation,
- Preparation of plan and Transportation Improvement Programs (TIP),
- Operation and feedback.

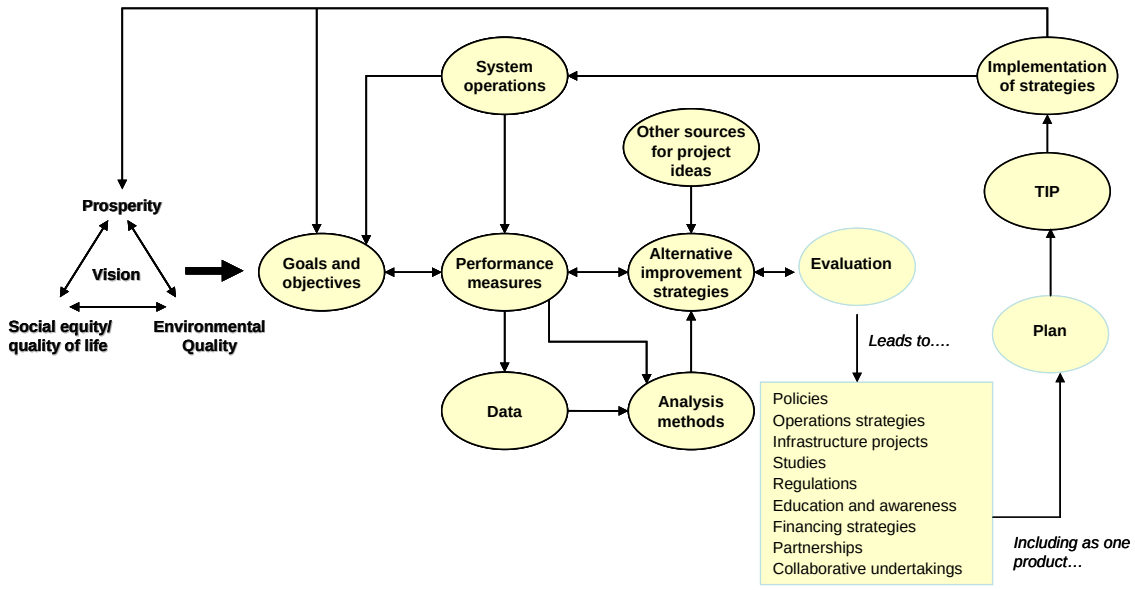

FIGURE 2 Steps in Transportation Planning.

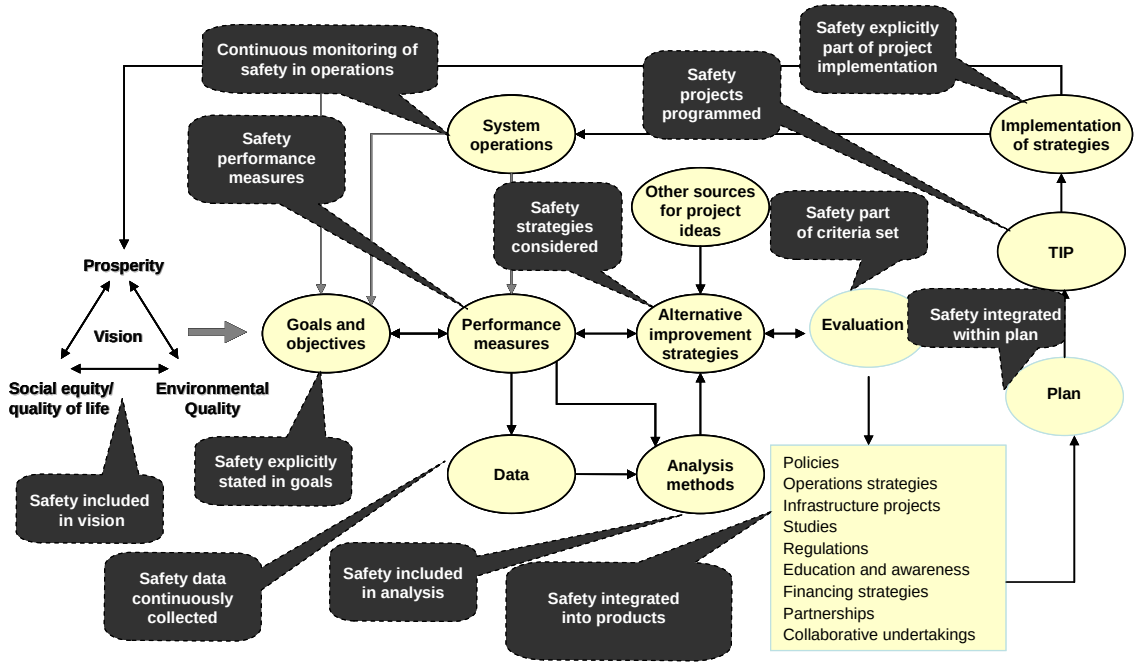

FIGURE 3 Consideration of Safety in the Conceptual Transportation Planning Process.

Each section of the guidebook provides a series of questions to help assess the current status of safety planning by an agency, suggested steps to more proactively address safety in planning, examples of how agencies have done so, and specific activities that agencies can do to meet the steps. For example, the section on performance measures includes five diagnostic questions, including the following three:

- What are the most important safety-related characteristics of the transportation system that resulted from community outreach efforts to date? If performance measures are used, are these characteristics reflected in the articulated set of performance measures?
- Will the safety performance of the transportation system (as defined in the performance measures) likely respond to the types of strategies and projects that will result from the planning process? That is, are the performance measures sensitive enough to discern changes in performance that will occur after program implementation?
- Is the number of safety performance measures sufficient to address the safety concerns identified in the planning process? Alternatively, are there too many safety measures that could possibly "confuse" one's interpretation of whether safety is improving?

For improvement steps, the guidebook suggests that agencies review safety-related performance measures used by similar agencies in the United States, prepare a limited set of performance measures that reflect the goals and objectives, and then review the measures with data collection agencies and transportation modelers, among others. The performance measures section also includes examples from the Florida DOT and MnDOT.

The guidebook spends considerable time reviewing historical, current, and potential future tools to assist with planning for safety. Detailed reviews of these tools are included as appendices. However, the guidebook also indicates that, among other improvements, the current transportation planning process needs a range of analytical tools for assessing and incorporating safety, sketch planning tools for better project-level analysis, and guidance as to when and how specific tools should be used. Towards this end, the guidebook will include discussion of a new tool that allows forecasting of crashes at the traffic analysis zone (TAZ) level; this tool was prototyped as part of NCHRP Project 8-44.

One of the last guidebook sections presents a discussion of how agencies can bring together all suggested steps to produce a transportation planning process that more thoroughly integrates safety considerations. The key questions and activities are brought together in a series of tables at the end of the guidebook. The guidebook concludes with a presentation of research challenges in the area of safety planning; these challenges include

- Institutional strategies for collaboration;
- Determining safety benefits over a planning horizon;
- Determining safety benefits of noninfrastructure strategies;
- Prioritization schemes and approaches;
- Multimodal perspectives on safety and consideration of urban design;
- Better models and information systems; and
- Data access, quality, and use of emerging technologies.

ROUNDTABLE DISCUSSION ON STATE DOT EXPERIENCE WITH USING GUIDEBOOK PRINCIPLES

Following Meyer's presentation, Janet D'Ignazio facilitated the peer exchange on addressing safety in planning. Unlike the cost-estimation discussion, the safety exchange was organized around the four individual prompting questions (instead of agency by agency). The following points were raised during the discussion:

- The approach presented in the initial draft guidebook was good, particularly the idea of orienting safety planning around the general transportation planning process. Such organization served the dual purpose of educating nonplanners on the complex nature of the transportation planning process.
- The guidebook could be simplified, streamlined, and reorganized for quick application by practitioners, and additional sidebar examples and discussions (e.g., legal issues) could be added.
- The actual content of the guidebook was discussed at length. Some individuals were looking for a more formulaic approach to conducting safety-conscious planning. Others were looking for a more general discussion of important safety issues and wanted to avoid a procedural manual that could be interpreted as willingness by the transportation profession to take responsibility for all safety issues.

PRESENTATIONS ON EXPERIENCE WITH ADDRESSING SAFETY IN TRANSPORTATION PLANNING

Participants from California, Florida, Montana, and Binghamton, New York, gave extended presentations of how their agencies are addressing safety and also provided detailed responses to the four prompting questions.

California

Safety is the lead issue in the vision statement in Caltrans's SWTP, and Caltrans also has a strategic plan that has safety as the first goal. Allocation of dollars to safety projects occurs at a very high level in California's biennial STIP process. Safety is the first priority during prioritization discussions, and given the current budget situation, safety projects will be funded before maintenance and preservation. California has a goal of reducing vehicle crashes by 12.5%; this goal was established subjectively with an eye toward the likely level of available funding.

Caltrans is becoming more aggressive in reviewing the safety impacts of other's activities. Caltrans actively participates in reviews of safety issues through the California Environmental Quality Act (CEQA) and other planning processes. Caltrans now also expects cities, counties, and developers to address safety impacts of new development and local proposals. Caltrans expects to generate about $200 million per year in additional funding for safety projects through this initiative. State court cases have upheld this process as long as a strong nexus remains.

Caltrans has a gap in establishing performance measures and generating data at the local level and for nonmotorized modes. They also have a gap in safety data for ancillary facilities such as park-and-ride lots.

Fragmented decision making and responsibilities for safety present major barriers in California. About 75% of state and federal money for new projects gets programmed by MPOs and other regional planning agencies. However, this percentage is calculated on net funds, which excludes the takedowns for Caltrans's safety and preservation activities. These takedowns tend to generate interagency tension. A second point of tension occurs in the STIP process since many MPOs and regional agencies view state highways as "not their responsibility" even though needs may exist. Caltrans faces other barriers in terms of a backlog of crash data, lack of investment in freight movement projects, and lack of priority for safety among elected officials. Tort liability is a huge issue for Caltrans in that they lose $50 million per year in budget from court cases; this liability creates an unwillingness to use crash data for educational purposes.

Binghamton

The Binghamton Metropolitan Transportation Study (BMTS) has just initiated an update of its Regional Transportation Plan (RTP). Most framework elements are built into BMTS's current planning activities. For example, the RTP has safety goal and performance measures as well as many objectives dealing with pedestrian safety, rail–highway grade crossings, etc. BMTS has a point rating system for TIP development that includes safety. The practice of determining how much is spent on safety versus other priorities is not particularly meaningful, since each project has multiple components. The RTP does not include a lot of safety-specific projects; rather, it tends to focus more on the short-term identification of safety problems.

BMTS sponsors a local engineering assistance program to provide traffic engineering services to local jurisdictions. This program tends to emphasize safety and has been very effective in improving credibility with local jurisdictions. BMTS wants to address safety more proactively for the future (e.g., increase in elderly populations in certain parts of the region). However, the agency struggles with whether anticipatory investments should be made if the data do not suggest a current problem.

BMTS's planning activities do not integrate well with enforcement and education. BMTS faces data ownership issues (e.g., the state DOT has implemented its own system to process and distribute crash data due to perceived problems at other state agencies).

BMTS is attempting to do some cross-fertilization of safety benefits between mode-specific investment plans. For example, it is trying to improve pedestrian safety and implement its pedestrian and bicycle plan through investments that will increase sidewalk access to transit stops.

Florida

Safety is the top issue in Florida's SWTP. Safety is incorporated in all goal areas and the entire framework for FDOT's short-range component. FDOT assesses safety exposure on a vehicle mile–traveled (VMT) basis rather than per capita due to a large number of tourists in the state. Crash and fatality targets in the SWTP were set to try to achieve the national average over time; interim targets within the short-range component are viewed as an incremental step.

FDOT's Strategic Highway Safety Plan (SHSP) is an internal document that was developed as an outgrowth of the agency's strategic plan. The SHSP has five major emphasis areas:

- Keep vehicles in the proper travel lane and minimize the effects of leaving travel lanes,
- Improve the safety of intersections,
- Improve access management and conflict point control,
- Improve information and decision support systems, and
- Improve pedestrian and bicycle safety.

The SHSP was born out of recognition that there was no alignment between generalized statewide safety concerns and actual safety initiatives at the local level. Issues such as the lack of availability of predictive models and desires to be more proactive were factors in its creation. The SHSP has moved safety discussions from the grassroots level to the statewide, strategic level. Florida now also has multiagency task forces for safety. These community safety focus teams, which meet monthly, include representatives of highway safety advocates, law enforcement, traffic engineers, and others. However, FDOT always faces struggles as it attempts to balance its safety initiatives against the public's expectations of personal freedom.

System performance measures are incorporated into legislative budget measures in Florida. Safety and congestion are used as programming considerations for projects on the Florida Intrastate Highway System (FIHS). FDOT is beginning a transition from a milepost tracking system to a GIS tracking system for crash records. FDOT is also incorporating safety into its Plans Preparation Manual. The agency expects to have to do additional internal work so that safety is more thoroughly integrated into design, construction, and maintenance activities.

Montana

MDT has been following a process similar to the one presented in the initial draft guidelines for many years. Montana has a statewide comprehensive safety plan and explicitly considers safety in its capital programming process. Environmental documents for all MDT projects have safety as a component in the Statement of Purpose and Need.

There has been an extensive focus on impaired driving and primary seat belt use in Montana. MDT was very proactive in getting these initiatives passed through the legislature, and it continues supporting aggressive programs focused on driver behavior.

MDT is currently spearheading an effort to bring together the leaders of other safety-related agencies to decide on the next set of activities. There is some talk in Montana of instituting a defensive driving course for 16 to 18 year olds. A pilot test of this course will be done in the next few years using $150,000 in State Planning and Research (SPR) funds (over 4 years).

MDT's Systems Impact Analysis Process (SIAP) requires developers to mitigate the potential safety impact of their project proposals. All developers are required to follow this process if MDT review is required; this process and mandate have withstood legal challenges. MDT has found that the SIAP, which includes specific design requirements, generally leads to the inclusion of roadway elements such as turn lanes, traffic signals, and acceleration and deceleration lanes.

MDT has experienced difficulty gathering crash data from state highway systems on tribal land. Only about 15% of roads within tribal land are state highway, but only one of seven tribal governments in Montana is willing to share its crash data. MDT has found that fatality rates on state highways on tribal land are three times the statewide average, yet the agency has difficulty in finding effective education and enforcement mechanisms with tribal governments.

MDT has given transponders to highway patrol so that they can pinpoint crash locations, and the entire highway system is geocoded. MDT wants better data on attributable causes and location so that they can truly pinpoint potentially effective actions and which of the "4Es" (engineering, enforcement, emergency services, and education) need to be addressed. MDT sees two major challenges in the future as it continues its aggressive safety program: (1) jurisdictional boundaries and (2) interact with tribal governments and cultural differences.

ACTION AGENDA FOR ADDRESSING SAFETY IN TRANSPORTATION PLANNING

Following the four presentations, the participants held an extended exchange to discuss key challenges to better address safety, institutional issues faced by the transportation profession, and near-term steps that can be taken to further advance this topic.

Challenges and Needs for Addressing Safety

The following issues were identified as challenges and needs facing the profession as it tries to better address safety as part of transportation planning:

- Better collaboration strategies between agencies with a stake in transportation safety.
- Better models, particularly with predictive capabilities.
- Tort liability and "paranoia" about predicting crash rates as part of LRTP. Does this concern hamper us from taking actions in advance of an observable safety problem?
- Better causal data on attributable factors for vehicle crashes is needed to identify the most effective initiatives for a jurisdiction.
- Predicting safety benefits of noninfrastructure initiatives.
- Better information on effective strategies for improving nonmotorized safety.
- Multimodal and urban design safety perspectives.
- Information and tools to address special situations such as vehicle–wildlife crashes or collisions with slow-moving vehicles (e.g., farm vehicles, Amish carriages, etc.)
- Integrating safety into TIP, STIP, SWTP, and RTP prioritization processes.
- A variety of data issues including timeliness, overall availability (especially for off-system data), privacy, data ownership, and agency transitions to GIS.
- Data collection and analysis capabilities for smaller MPOs. The Michigan DOT's CRASH program provides an example of how these data querying and analysis capabilities can be provided.
- Forecasting the growth in commercial and freight traffic.
- Encouraging planners to think of short-term strategies, which can be at odds with the typical long-range perspective of the transportation planning process.

- Overcoming the traditional perspective that an engineering solution is always available to solve a safety problem, and the general difficulty in engaging engineers and designers in safety planning.

Institutional Issues

Peer exchange participants also discussed institutional issues that stood in the way of addressing safety as part of transportation planning:

- Fragmented roles and responsibilities among transportation and nontransportation agencies that are responsible for traffic safety.
- General unwillingness of agencies to form partnerships to collect and connect data. This problem occurs between transportation agencies as well as others (e.g., courts, emergency medical services, hospitals, etc.).
- Unwillingness of transportation and nontransportation agencies to pool resources (staff and funding) to jointly address and fund safety initiatives.
- Acknowledging and addressing the trade-offs that are inherent between policy objectives including safety and others, for example, the safety implications of context-sensitive solutions (trees in medians or on sides of roads); striving for cost-effective capacity increases (restriping of shoulders); paving dirt roads to reduce particulate matter but getting increased crashes; reducing fatalities but increasing overall crashes (adding 3-strand guard cable in median of freeways).
- Need for better partnerships with tribal governments.
- Frequent lack of a public perception or realization that safety problems exist and what would be an effective strategy. For example, investments that do not change the road surface or alignment are sometimes perceived as wasteful spending to some members of the public.
- Lack of focus on safety issues by elected officials and other decisions makers until a major crash occurs.
- Effect that the judicial system has on education and enforcement activities, and, by extension, the effectiveness of safety programs.
- Real or perceived issues with agency liability related to collecting and analyzing data, predicting future safety conditions, and implementing solutions.
- Assuring more uniform application of traffic laws.

APPENDIX A

Responses to Questions on Cost Estimating for Transportation Planning, Programming, and Preconstruction

CALIFORNIA

What are the major issues you are facing regarding planning or programming cost estimates?

- Regulatory agencies' requirements for mitigation,
- Cost escalation between scope development and programming

(material and labor cost, R/W acquisition, etc.),

- Cyclical nature of transportation funding (boom or bust), and
- Consistency of purpose and need.

Describe policies, procedures, techniques, and standards used in preparing planning and programming conceptual estimates. If these policies, procedures, techniques, and standards are documented (written), can you provide us with a copy or a website location where we can obtain a copy?

- The department, being a responsible fiscal manager, develops reliable cost estimates, which ensures credibility with our transportation partners and customers including the California Transportation Commission (CTC), the legislature, regional and local agencies, and the public.
- Planning cost estimates are used for project justification, analysis of alternatives, approval, and programming.
- Use Project Study Report (PSR) for initial programming decision.
- PSRs include capital and support costs.
- Update estimate in draft project report and environmental document/approval (PA&ED).
- .Review and update estimate at least annually.
- Final engineers' estimate in PS&E.
- PS&E cost estimates or project contract's work items will be a part of the construction contract.
- Manage cost through bidding stage and construction management.
- Please refer to the project development procedures manual, *Guidance on Cost Estimating*, which can be found at http://www.dot.ca.gov/hq/oppd/pdpm/chap_htm/chapt20/chapt20.htm

How do you ensure that conceptual estimates reflect all elements of project scope (e.g., related to design, construction administration, construction, right-of-way, environmental, etc.) as defined at the time conceptual estimates are prepared?

- Cost estimating is not an exact science.
- Project cost estimates must be prepared using a consistent and comprehensive methodology.
- Effort requires research (track trends) and use of professional judgment.
- A project engineer leads a cross-functional team that includes planning.
- Employ risk management techniques.
- Minimize scope creep.

What types of historical data do you use as a basis for preparing conceptual estimates? How are these data adjusted for time (schedule), location, and other project-specific conditions?

- Every year Caltrans produces the construction cost data book. It provides designers and estimators with historical data on unit prices by district and quantity. This is an invaluable reference to those producing estimates. http://www.dot.ca.gov/hq/esc/oe/awards/
- There is also the memo on annual review of scope, cost, and schedule at http://www.dot.ca.gov/hq/oppd/design/m112299.htm
- And there is the memo on price escalation at http://pd.dot.ca.gov/design/memos/Bid_Item_Price_Escalation.pdf

How are contingency amounts incorporated into the estimate? Are contingency amounts based on total estimated cost, identified project risks, or some other variables?

- The planning cost estimate contingencies are factors based on the confidence and detail provided in developing the estimate. Typically the greater the detail provided, the lower the percent factor.
- Contingencies include minor items of work that will be defined in more detail later and addressing the unknowns.

Factors used at various stages of the project are

- PSR stage = 25%,
- Draft project report = 20%,
- Final project report and PA&ED = 15%,
- PS&E stage = 5%, and
- An inflation factor is applied to inflate estimates to programming fiscal year: typically 3% to 3.5% (based on degree-of-freedom recommended inflation rate).

FLORIDA

What are the major issues you are facing regarding planning or programming cost estimates?

Developing accurate project cost estimates is essential and a very high priority for the Florida Department of Transportation (FDOT), particularly as it relates to several key provisions in state law. Pursuant to Section 339.135(4)(b), Florida Statutes, the department must minimize changes to project phases included in its 5-year work program. This is important, since the entire 5 years of the Adopted Work Program for facilities designated as part of the Florida Intrastate Highway System, and the first 3 years of the Adopted Work Program, stand as the commitment of the state to undertake transportation projects that local governments may rely on for planning purposes and in the development and amendment of the capital improvement elements of their local government comprehensive plans. The Florida Transportation Commission annually evaluates FDOT performance in maintaining a "stable" work program. The following is a link to the most recent Performance and Production Review of the Department of Transportation: http://www.ftc.state.fl.us/fy02-03.pdf.

While FDOT has generally been able to maintain work program stability, the department continually seeks to improve the accuracy of project cost estimates. A variety of factors can affect the accuracy of the department's cost estimates. For example, at the time planning or programming cost estimates are developed, there may be inadequate information about

- Project scope;
- Right-of-way needed and associated costs (e.g., acquisition, relocation, business damages);
- Required environmental, migration, and other design accommodations needed to avoid adverse environment, historical, or cultural resource impacts;
- Community impacts (and needed mitigation), expectations, and acceptance; and
- Future development that affects level of service.

Describe policies, procedures, techniques, and standards used in preparing planning and programming conceptual estimates. If these policies, procedures, techniques, and standards are documented (written), can you provide us with a copy or a website location where we can obtain a copy?

Construction Costs

During the planning phase, construction cost estimates for the Florida Intrastate Highway System (FIHS) are developed by FDOT. Cost estimates for metropolitan planning organization (MPO) long-range transportation plans are developed by the MPOs. FDOT prepares a document entitled the Transportation Cost Report, which can be used by FDOT and MPO planners when developing preliminary cost characteristics of transportation facilities. The following is a link to the most recent issue of this report: http://www.dot.state.fl.us/planning/policy/pdfs/TransCost.pdf.

The Transportation Cost Report includes information about highway construction and maintenance costs, public transportation costs and characteristics, and inflation factors for

adjusting cost data. This information is based on statewide estimates only. Since average costs may vary significantly from one district to another, some FDOT districts opt to maintain district-specific information for their planners. The FDOT Long Range Estimate System is the major source of information for highway construction costs used in the Transportation Cost Report.

When construction projects are added to FDOT's Five-Year Work Program, the cost estimates must be prepared using the FDOT Long-Range Estimate (LRE) System. FDOT has a procedure governing the development of cost estimates entitled "Documentation of the Five-Year Work Program Construction Cost Estimates." (This procedure is attached separately.)

The LRE system is a computerized program that produces construction cost estimates when projects are in the conceptual and early plans stages, before actual design plan quantities are available. The system includes typical cross-section models for new construction, resurfacing, and widening projects. FDOT estimators modify the models to reflect the characteristics of a project. LRE generates the cost estimates of the project (i.e., items, quantities, and prices) based on the physical characteristics of the typical sections as coded, for the indicated roadway length and current construction price trends. LRE(s) are updated annually, when design scope is prepared and at Phase I (30%) & Phase II (60%) plans development.

Right-of-Way and Engineering Costs

During the planning phase, the right-of-way (ROW) and engineering costs are developed based on ratios of the historic relationship of these costs to construction costs. For Work Program cost estimates, each District Right-of-Way Manager is responsible for developing the ROW estimates, using a database system called the Right-of-Way Management System. This database maintains historic cost factors from ROW projects in the district. ROW cost estimates must be updated at least annually.

Efficient Transportation Decision Making

FDOT has recently implemented a new program, the Efficient Transportation Decision Making (ETDM), which will assist in improving the accuracy of cost estimates in long-range plans and the Work Program. This process involves environmental and other resource agencies in the review of projects included in long-range transportation plans and candidate projects for the Work Program. Pursuant to the ETDM process, potential community impacts or concerns are also evaluated and documented. In this new process, avoidance and minimization strategies are identified much earlier and the cost impacts for these strategies can be built into the project cost estimates. The following are links to websites about the ETDM process:
http://fdotenvironmentalstreamlining.urs-tally.com/
http://fdotenvironmentalstreamlining.urs-tally.com/Library/FDOT-Streamling%20Brochure-Rev.pdf.

How do you ensure that conceptual estimates reflect all elements of project scope (e.g., related to design, construction administration, construction, right-of-way, environmental) as defined at the time conceptual estimates are prepared?

Pursuant to the Department's "Documentation of the Five-Year Work Program Construction Cost Estimates" procedure, a candidate construction project cannot be added to the Work

Program unless it includes an LRE-based construction cost estimate. The project manager is responsible for maintaining a current scope of work for each project and providing this information to the individual developing or updating the LRE cost estimate. The quality of the estimate is directly related to the estimator's complete and accurate knowledge of the project's scope of work.

Annually, the Central Office's Estimates Office reviews the LRE cost estimates programmed in the work program and works with district estimates staff to review any issues to resolve discrepancies. To assist in this effort, a variance report is prepared annually listing projects with cost estimates that fall outside the tolerance range or lacking an LRE-based cost estimate. A cost estimate from the Trns*port system may be used in lieu of an LRE if project design has progressed to Phase III (90%) plans where pay items and quantities are developed.

Pursuant to state law, each MPO must establish a technical advisory committee that reviews MPO products and plans. FDOT staff are members of the technical advisory committee (other members may include planners, engineers, representatives from local public transit authorities, aviation authorities, local governments, etc.). District staff will comment if they determine that cost estimates used in MPO long range plans appear low.

What types of historical data do you use as a basis for preparing conceptual estimates? How are these data adjusted for time (schedule), location, and other project-specific conditions?

The pay items and unit prices in the LRE system are derived from the Trns*port system database, which includes data from FDOT contract lettings. Trns*port is a suite of computer products designed for project estimating, contract letting, and construction administration. LRE reflects statewide, market area, and county averages of these unit prices. LRE unit prices are updated semiannually and include an "ad hoc" pricing feature so the estimator can adjust the unit prices for the specific conditions on the project (location, specialty work, current market trends, etc).

How are contingency amounts incorporated into the estimate? Are contingency amounts based on total estimated cost, identified project risks, or some other variable?

The department plans for contingencies in developing the initial construction costs and reserving funds to cover contingencies for all phases of a project at the program level.

Contingencies that are included in the cost estimates of specific construction projects are based on 5% of the estimate up to $50,000 for projects $5,000,000 or less and 1% of the estimate up to $150,000 for projects more than $5,000,000. Construction contingency amounts are included to cover changes in design and unforeseen work items at the early stages of construction. The LRE contains a "scope creep" factor that allows the estimator to increase the cost of a project, in anticipation of future changes to the scope work. Scope creep is used to include the cost of work that potentially could become a part of the project.

Contingency amounts to cover supplemental agreements for existing projects, pending litigation, and estimate increases are identified and programmed in FDOT plans and in the Five-Year Work Program for the highway and bridge programs. Funds programmed to cover contingencies in the department's Five-Year Work Program typically range from 10% to 12% of the amounts programmed for specific project phases (design, right-of-way acquisition,

construction, and inspection). These funds are usually not included in specific project estimates but are programmed as separate items that are referred to as "box items." For future plans (examples include the FIHS 2025 Cost Feasible and Ten-Year Plans), contingency amounts are set aside for future anticipated changes in scope, estimate changes, supplemental agreements, and potential claims for the projects included in the plans as a whole (i.e., not on specific projects).

MICHIGAN

What are the major issues you are facing regarding planning or programming cost estimates?

Following are the major issues facing the Michigan Department of Transportation (MDOT) as it relates to planning or programming highway cost estimates.

- A major issue in planning–programming cost estimates is being able to consider all the costs associated with the potential project, for example, all the needs, condition goals, entire project influence area and coordination (local and state), and maintaining updated cost estimates. The challenge is to have good, up-to-date information early in order to develop a complete and comprehensive project scope.
- In 2002, Michigan experienced an early-out retirement that resulted in a significant number of experienced staff retiring. Because of the lack of experienced staff to make the estimates, initial project cost estimates may not be complete or completed correctly.
- Maintaining scope (what is needed vs. what would be nice) and adequate funding. Some projects are estimated based on available funding, and these projects will often suffer scope creep as they are developed. Staff will add what they think is appropriate, with no understanding of why and what was originally scoped or budgeted.
- Unpredictable changes, such as modification to departmental specifications, policy, or procedures after initial estimate, or fluctuations in the economy, cause cost estimates to change. For example, the requirement for high quality pavement markings is a new added cost to our projects, or lack of suppliers raises prices.
- Many projects are scoped and designed at the regional level where staff has more localized and detailed information. However, the final estimates are made at the central office based on statewide trends. Discrepancies may result in changes to cost estimates prior to the project being let to bid.
- For larger projects, the pavement selection process is completed after design has started, due to Michigan's life-cycle costs analyses laws. This has the potential for changing the project cost as originally scoped.
- The smaller and more tightly estimated and controlled programs and budgets (bridge, traffic, and safety) appear to have fewer smaller budget adjustments. Very large urban area programs (road and bridge) have larger and more numerous budget changes than our smaller rural programs.
- Occasionally project estimates are "low balled" to get a project into our plan; then the project suffers scope creep during the design stage. This appears to be occurring less frequently

since we have gone to a decentralized programming process that holds the regions accountable and responsible for maintaining a constrained program.

- In analyzing our budget change requests, it can be seen that the median of the change amounts is much smaller than the average change amounts. This indicates we typically have numerous small changes in budget.
- Politics versus needs of our system; "you cannot take the politics out of politics."

Describe policies, procedures, techniques, and standards used in preparing planning and programming conceptual estimates. If these policies, procedures, techniques, and standards are documented (written), can you provide us with a copy or a website location where we can obtain a copy?

These are done on an annual and regional basis for the preservation program as part of the call for projects and include technical experts and local staff or consultants, if necessary (TSC, region, Lansing), local agencies, and citizens. By using the condition goals, condition (road and bridge) data, regional strategies (corridor project approach, etc.), corridor needs (condition, capacity, maintenance, geometrics, development), politics, funding levels, etc., candidate projects are selected. Usually, you can start from a working list of concepts from previous years' efforts.

The next step is to gather all information for the proposed project and visit the site (with appropriate staff) and develop the fix and scope (with all tools needed—history, condition, 3R/4R specifications, etc.), prepare a preliminary estimate using up-to-date estimating tools (and unit prices), contingency rates, engineering percentages, geometric guidelines, and 3R/4R standards. Check the scope and estimate for accuracy. And, finally, submit the project for final approval.

The general approach to scoping preservation projects has been documented, but the documents are not available on the website.

How do you ensure that conceptual estimates reflect all elements of project scope (e.g., related to design, construction administration, construction, right-of-way, environmental, etc.) as defined at the time conceptual estimates are prepared?

Having the right people involved is key. With their input and working knowledge of the facility, most of the issues can be addressed. It is important to look at the facility, the rate of deterioration and what item(s) would need additional consideration for the deterioration. Maintaining the integrity of the estimate is done with contingency percentages in the project, good pay items, extra percentage contingency on items that have a higher deterioration rate, a check and confirmation on the scope, and a review of the estimate at Year 3, 4, and 5 of the Five-Year Program. Making sure that all areas (divisions) have input and assist in pricing out elements of their areas is also valuable (i.e., right-of-way, soils, traffic and safety).

MDOT's change request process is peer reviewed. This process requires that at least one other person is responsible to review all estimates prior to adding a new project to the program.

To our benefit, MDOT's public involvement and context-sensitive design processes are requiring MDOT staff to consider a much broader range of elements when developing conceptual estimates.

What types of historical data do you use as a basis for preparing conceptual estimates? How are these data adjusted for time (schedule), location, and other project specific conditions?

- When getting to the project-level consideration, the elements of the projects are known and taken into account with the estimating; a general percentage or rate per mile is not used. The schedule is looked at in several different ways, from time to construction, and contingencies or inflation factors may be used. If the schedule to get construction done is special (i.e., night work, 24 hours, part-width construction, etc.), additional percentage factors are used or costs for lane rental or incentive and disincentive costs are added to the projects.
- MDOT's bridge projects are estimated using estimated quantities and historical cost data that are updated periodically.
- MDOT utilizes many tools and reports in estimating project construction budgets, including TransPort, average unit price reports, and the proposal and estimating system.
- Using old estimates (for like projects), staff knowledge, pavement or bridge data (condition), maintenance logs, traffic data, design manual, standards, 3R/4R guidelines, AASHTO, geometrics, current pay item cost information, strategy information (i.e., RQFS), lessons from the previous years, and quality assurance and quality control methods.

How are contingency amounts incorporated into the estimate? Are contingency amounts based on total estimated cost, identified project risks, or some other variable?

Contingencies are usually established as a percentage of the total budget or large portion of work (road and bridge). The percentage may fluctuate based on the comfort level of the estimator.

Contingency, including inflation, deterioration rate percentages, and special work conditions are reviewed on a case-by-case basis for each project.

- Depending on the type of project, it could be all three or a variation of the three.
- Using inflation factors sometimes results in too conservative an approach and will tie up funding that could be used somewhere else.
- Factors considered are project location, deterioration rates of items, time of year, and type of construction.

MINNESOTA

What are the major issues you are facing regarding planning or programming cost estimates?

- The issue is not difficulty in estimating costs, but defining scope and managing scope creep. Project development can also be called the project "discovery process," which normally leads to alterations in project scope because of engineering decisions or to achieve local municipal approval.
- R/W costs are a major part of total project cost overruns. They lead to funding shortfalls and project deferrals.

- Variations in scope definition from initial concept in a long-range plan to project letting, and resulting variations in announced cost of project, may diminish MnDOT's professional credibility with the public and elected officials who do not understand the project development process.

Describe policies, procedures, techniques, and standards used in preparing planning and programming conceptual estimates. If these policies, procedures, techniques, and standards are documented (written), can you provide us with a copy or a website location where we can obtain a copy?

- Districts prepare a scoping document.
- Some districts are very careful to document the scope of the project as part of the long-range (20-year) district plan and 10-year work program so that, if scope changes, a historical record is available.

How do you ensure that conceptual estimates reflect all elements of project scope (e.g., related to design, construction administration, construction, right-of-way, environmental, etc.) as defined at the time conceptual estimates are prepared?

- Scoping document identifies all elements
- Fully controlling costs would require a change in management philosophy to one of a fixed project budget to force scope to be a function of available budget.

What types of historical data do you use as a basis for preparing conceptual estimates? How are these data adjusted for time (schedule), location, and other project-specific conditions?

- We are currently using an LWD (length, width, depth) estimating process. Data are updated annually, by region, which should provide better cost per unit than a statewide average.

How are contingency amounts incorporated into the estimate? Are contingency amounts based on total estimated cost, identified project risks, or some other variable?

- A true contingency amount is not currently included with conceptual estimates. However, as part of our long-range district planning, we have been discussing including a contingency (7% to 9%) for some types of projects.
- In the 3-year STIP, all districts have a set-aside for project supplement agreements and cost overruns. This doesn't cover all the increases in most cases.

MISSOURI

What are the major issues you are facing regarding planning or programming cost estimates?

At the conceptual stage of a project (identification of a need) the overall scope of a project has not yet been determined. This makes it difficult to develop an estimate. Because of this, the Missouri Department of Transportation (MoDOT) does not add the construction cost to a project in the STIP until it has been scoped.

How are contingency amounts incorporated into the estimate? Are contingency amounts based on total estimated cost, identified project risks, or some other variable?

Three percent contingency is added to the construction amount. Two percent per year is added for inflation to the construction and right-of-way amounts.

MONTANA

What are the major issues you are facing regarding planning or programming cost estimates?

A significant issue the Montana Department of Transportation (MDT) is facing with cost estimates is that the initial project nomination estimates are often substantially low. As the project moves through the preliminary development phases, costs often increase significantly. As MDT accepts project nominations based on a balanced budget program, these cost increases result in delaying projects because of funding availability. The delaying of these much-needed projects makes it nearly impossible for MDT to meet its system performance goals. Essentially, we find our dollars are buying less benefit than anticipated at the time of project nomination.

In an attempt to get a handle on the issue, MDT has initiated a research project to review current cost-estimating processes and develop recommended modifications to the process in the hopes of increasing the accuracy of initial estimates.

Specific areas of cost increases include expanding project scope, under estimated right-of-way costs, and underestimated utility relocation costs.

Describe policies, procedures, techniques, and standards used in preparing planning and programming conceptual estimates. If these policies, procedures, techniques, and standards are documented (written), can you provide us with a copy or a website location where we can obtain a copy?

MDT does not have a department-wide policy or procedure followed in developing project cost estimates. Montana is divided into five transportation districts, each of which uses a slightly different method, and combination of methods, for developing initial project cost estimates.

These methods include using project material quantities and recent bid item costs, comparisons with costs for similar historic projects in the area, and estimated costs per mile for the work type, transportation system, and scope of the project. Often a project quantity cost will

be developed and then checked against other cost-estimating methods, or used in conjunction with the other methods, to refine some of the nonquantity elements of the projects.

How do you ensure that conceptual estimates reflect all elements of project scope (e.g., related to design, construction administration, construction, right-of-way, environmental, etc.) as defined at the time conceptual estimates are prepaid?

As stated above, this is one of the issues that MDT faces in providing accurate initial project cost estimates. Currently, we do not have a checklist or process in place that ensures these project costs are included in the initial project nomination cost estimate. These costs are identified during the preliminary field review phase. This is generally the first step in the process that will give MDT staff an indication of the validity of the initial cost estimate. Any, and we hope all, scope modifications should be identified during the PFR phase.

What types of historical data do you use as a basis for preparing conceptual estimates? How are these data adjusted for time (schedule), location, and other project-specific conditions?

MDT uses historic bid item costs in preparing initial cost estimates. As we have no formal process, there is also no standard method for adjusting these historic numbers. However, MDT's district staff will use professional judgment to determine which project costs can be used to develop a valid estimate for future projects. The judgment will include consideration of location, time of year, and any project-specific conditions or issues that are expected to be similar or different from the future project.

Project cost estimates may be adjusted for inflation at the time of the preliminary field review if necessary. Generally the adjustment will be 3% per year.

How are contingency amounts incorporated into the estimate? Are contingency amounts based on total estimated cost, identified project risks, or some other variable?

MDT calculates contingency amounts based on percentages of total project costs. The percentage used varies depending on the project's work type.

OHIO

What are the major issues you are facing regarding planning or programming cost estimates?

- During planning we still do not know the exact routing, right-of-way, etc.
- We cannot estimate quantities.

Describe policies, procedures, techniques, and standards used in preparing planning and programming conceptual estimates. If these policies, procedures, techniques, and standards are documented (written), can you provide us with a copy or a website location where we can obtain a copy?

Cost estimating during planning is referred to as C-1 Estimating. About 8 years ago, the Ohio Department of Transportation (ODOT) attempted to put together some guidelines for estimating project costs. A set of guidelines was developed and distributed to the districts. However, the "hammer" to ensure these guidelines were followed was not put in place. Over this period of time, our districts have deviated from those guidelines in different degrees to the point where they have been left to their own devices to produce planning estimates to the best of their abilities.

The construction cost estimate guidelines were developed by a subcommittee of district and central office personnel and are divided into two types of estimates:

- C-1 estimates ("C" for construction, "1" for the first phase or stage) are estimates that were created when there were no quantities, no items of work, and no real plans created. They are the conceptual estimates, usually performed by the planners. The estimating tool created for C-1 estimates was a template that began with identifying the type of work to be performed. Major cost drivers were defined for each work type, and rough quantities were calculated for that work. Bid histories (based on the work type and the quantities) were then used to estimate the cost of the major cost drivers. Finally, a percentage of the major costs was added to account for the other ancillary work on the project. This ancillary cost percentage was derived by looking at ancillary costs of other projects of the same work type.
- C-2 ("Construction - Phase 2") estimates were created after we had plans drawn, with items of work identified, and quantities defined. C-2 estimates typically are performed by the production personnel. The C-2 estimating tool that the districts are still using is called Estimator, a software package that is licensed annually from AASHTO. Since estimates are created using defined items of work and specific quantities, the software can perform estimates using many different methods: cost-based, bid (history)-based, reference pricing, ad hoc pricing, etc.

Where does that put us today? The ODOT Ellis and Jobs and Progress Projects Initiatives are giving us our best chance at moving forward to a well-designed, consistent process for creating a C-1 (planning) estimate. In August 2004 the Office of Estimating was scheduled to begin meetings with planning and production representatives from all districts to determine how they perform their C-1 estimates. We will consolidate the results of these discussions and create C-1 estimating guidelines that take into account the best practices of all districts. This will be ODOT's standard process for performing C-1 estimates. A quality assurance review process will be set up to ensure districts are following proper procedures. Also, a new estimating subcommittee (representation from district planning and production, and central office) will be formed to oversee the process as it evolves to address new estimating tools, philosophies, innovations, etc. Obviously, the first priority for ODOT's C-1 estimates will be for the jobs and progress projects. We believe, however, that as soon as that is under way, the same techniques can be used for all projects within a district program.

In the grand design of things, we are looking ahead to the day when ODOT begins to use the C-1 estimating capabilities of another AASHTO software product called the Cost Estimation

System (CES). We are currently using a portion of this module to perform our official letting estimates. There will be a day when we will be able to roll out this software to the districts to perform C-1 estimates. ODOT is also participating in the AASHTO development of a new software product called TRACER which will enhance the current capabilities of CES. TRACER will be available in early 2006.

How do you ensure that conceptual estimates reflect all elements of project scope (e.g., related to design, construction administration, construction, right-of-way, environmental, etc.) as defined at the time conceptual estimates are prepaid?

ODOT has implemented a computer-based tracking system for all projects (Ellis as referenced above.) Districts and project managers are required to update, monthly or as information becomes available, the cost estimates. C1 cost estimates are continually changing as the project advances.

What types of historical data do you use as a basis for preparing conceptual estimates? How are these data adjusted for time (schedule), location, and other project-specific conditions?

Each district uses recent bid histories from its area and adds a percentage factor for inflation.

How are contingency amounts incorporated into the estimate? Are contingency amounts based on total estimated cost, identified project risks, or some other variables?

Usually a 10% to 20% contingency based on the total estimated cost is added.

PENNSYLVANIA

What are the major issues you are facing regarding planning or programming cost estimates?

The major issue currently facing planning and programming is determining the level of funding that will be available. Not knowing the funding available can cause delays in schedules and change construction scope of work. For projects developed by others, the original scope is often too vague and generalized such that not all associated project issues and impacts are included in the scope. Original scope may not consider planned development and other transportation projects in the area.

Describe policies, procedures, techniques, and standards used in preparing planning and programming conceptual estimates. If these policies, procedures, techniques, and standards are documented (written), can you provide us with a copy or a website location where we can obtain a copy?

On short-term projects such as highway restoration, the project is field viewed and work identified in cooperation with the other units involved. Rough quantities of major items are

estimated, and costs are based on recent bid prices of similar projects. Contingency items are included and may be adjusted to allow for minor items, inflation, complexity, etc. Sometimes these projects are downscaled or the limits shortened to match the funds available. It seems that more complex projects are estimated based on size and complexity of the project, and programming estimates are based on similar completed projects.

In other cases, for conceptual estimates, an estimated value can be calculated based on rules of thumb without estimating unit quantities, for example, costs per mile, costs per interchange, costs per intersection, and structure costs per square foot. All estimates require some common sense adjustments. A mile of roadway is going to be significantly higher in a highly urbanized location than in a rural situation.

When the project progresses into the early stages of design, such as that required to support the environmental document, an estimated quantity and unit cost are developed, with a rule of thumb per unit, or a percentage of major items approach is used. For example, the engineer may estimate quantities for the major items, such as earthwork, pavement, and structures, and apply a unit cost to those quantities. Other items, such as drainage, signing, E&S, etc., may be calculated as a percentage of the major items. These percentages will vary based on project location and type. Another approach is to estimate the other items on a per mile basis. For example, drainage may be calculated at $x per mile. All known items are accounted for by either quantity x unit cost, a percentage of the major cost items, or cost per mile for a particular item(s). A contingency amount is added to account for unknown risks. At the environmental stage, we normally use a 30% contingency.

As the design progresses, the number of items calculated based on quantities and unit costs increases, and those items estimated based on percentage or costs per mile estimates decrease. The contingency amount also decreases. Eventually the final estimate will be based entirely on a quantity and unit cost basis. The contingency will be eliminated entirely or significantly reduced. For some projects or for some items, a scratch construction estimate may be performed.

How do you ensure that conceptual estimates reflect all elements of project scope (e.g., related to design, construction administration, construction, right-of-way, environmental, etc.) as defined at the time conceptual estimates are prepared?

We coordinate with the involved units to determine scope and costs for all anticipated work.

What types of historical data do you use as a basis for preparing conceptual estimates? How are these data adjusted for time (schedule), location, and other project-specific conditions?

We use historical cost data and costs of recently let projects of a similar nature. The estimator may adjust these costs up or down to allow for schedule, location, project conditions, etc.

How are contingency amounts incorporated into the estimate? Are contingency amounts based on total estimated cost, identified project risks, or some other variable?

Contingency amounts are based on total project cost and are typically 10% to 15% and are selected depending on the confidence level (risk) of the estimate. In other cases we may use 30%

in the environmental phase, 15% to 20% for a design field view submission (30% design), and continue to decrease to nothing or a very small percentage in the final estimate. PennDOT advises 15% to 20% for the design field view submission but provides no other standards for other stages or submissions.

UTAH

What are the major issues you are facing regarding planning or programming cost estimates?

- Maintaining credibility of cost estimates made at the planning level.
- Producing a program of projects that consistently stay within a reasonable range of the estimated costs.
- At the present time the escalation of some material costs and fuel costs have created challenges.
- Right-of-way remains a challenge to estimate.

Describe policies, procedures, techniques, and standards used in preparing planning and programming conceptual estimates. If these policies, procedures, techniques, and standards are documented (written), can you provide us with a copy or a website location where we can obtain a copy?

At this time, the Utah Department of Transportation (UDOT) is in the process of developing policies and procedures to improve the cost-estimating process. Methods are being investigated to narrow the range of estimates by applying more probability and risk analysis.

How do you ensure that conceptual estimates reflect all elements of project scope (e.g., related to design, construction administration, construction, right-of-way, environmental, etc.) as defined at the time conceptual estimates are prepared?

UDOT is proposing to develop some kind of peer group oversight or review to formally consider several aspects and areas of expertise. This group will take a "value engineering" type of approach to reviewing and establishing the final estimate. A performance matrix will be established and used to improve this process.

What types of historical data do you use as a basis for preparing conceptual estimates? How are these data adjusted for time (schedule), location, and other project-specific conditions?

UDOT has been using the typical historic cost data as a basis and adjusting for inflation and changing conditions. Location is taken into consideration based upon the source of the base data.

How are contingency amounts incorporated into the estimate? Are contingency amounts based on total estimated cost, identified project risks, or some other variable?

In the past, this process has incorporated more of a subjective analysis and application of contingency factors or amounts based upon experience applied to the site and circumstances. In the future, UDOT hopes to be able to use the performance of a more analytical structured system to make any final adjustments.

VERMONT

What are the major issues you are facing regarding planning or programming cost estimates?

- Historically, planning and programming cost estimates have been lower than the construction cost.
- Lack of staff capacity to maintain current average square footage costs. Absent an averages table, the staff must collect data and generate estimates for each conceptual project design or for revisions in subsequent project development stages. Obviously, this repetitive task is inefficient.
- By their nature, some projects take longer to move through the project development process than others. The construction costs of those that take several years inevitably cost significantly more than the planning estimates, even when inflation is factored in.
- Consistent procedures are not used by project managers, which makes it impossible to calibrate and gauge performance of methods used. Procedures developed in the past have not been updated over time with current parametric cost data due to the lack of commitment by project managers to the practice of producing quality planning, programming estimates, or both. In essence, the lack of updates is a product of no one committing resources or personnel to perform the needed tasks. Therefore, it is possible to currently find a different method used by a number of different project managers. Planning and programming estimates produced in this manner offer no guidance toward a potential agencywide improvement in this area because of the lack of consistency in methods used. In analogous terms, if one were trying to develop a system or procedure to build widgets it would be best to focus a team on the refinement and improvement based on previous performance of a good system rather than to have all of the different team members seeking to develop a mediocre system of their own. Procedures for planning or programming cost estimates are available within the agency; they just need to be updated annually and must be required to be used for every estimate produced. This would require 2 to 3 weeks of analysis a year by one individual from respective sections, most likely an engineer, to develop and provide updated parametric cost data and procedure performance assessments that may result in recommendations for improvements to the cost models.

Describe policies, procedures, techniques, and standards used in preparing planning and programming conceptual estimates.

- Bridge programming estimating procedures are contained in Chapter 26 of the 2001 edition of the *Vermont Agency of Transportation Structures Manual*. (http://www.aot.state.vt.us/progdev/Documents/Structures/2004_Structures_Manual.pdf)
- Roadway construction estimates are based on FHWA's average per mile cost for type of project. The unit costs used to develop the estimates were last updated in 2002.
- AASHTO's Estimator software is used to estimate structure project costs when possible in the statewide plan's conceptual estimates where major cost line items for the project have been determined.
- The project manager establishes the estimated conceptual project cost using methodologies described above and further refines the estimates using professional judgment.

How do you ensure that conceptual estimates reflect all elements of project scope (e.g., related to design, construction administration, construction, right-of-way, environmental, etc.) as defined at the time conceptual estimates are prepared?

- The project manager is responsible for estimating all the associated costs when preparing conceptual estimates.
- The project manager uses professional judgment to determine an appropriate percentage to be applied to the conceptual construction cost estimate for the respective cost elements (i.e., 15% preliminary engineering, 10% construction engineering, etc.).

What types of historical data do you use as a basis for preparing conceptual estimates? How are these data adjusted for time (schedule), location, and other project specific conditions?

- A chart of costs by size and area of bridge has been used by the structures unit to estimate bridge costs at the conceptual stage. The chart data is currently 15 years old.
- Actual bid data is used to prepare conceptual roadway and bridge estimates when major cost line item quantities have been determined. The estimates are prepared in present day dollars, and adjusted annually as necessary in the capital program to reflect future value.
- Unless the Estimator program is used to determine unit prices for major cost line items, there is no accepted consistent method for adjustment of location and other project-specific conditions. Typically, no adjustments are made for these cost elements at this stage of project development.

How are contingency amounts incorporated into the estimate? Are contingency amounts based on total estimated cost, identified cost, identified project risks, or some other variable?

- Contingency amounts are set by the project manager and are based on his or her judgment.
- Contingency amounts vary according to the size and complexity of a project, from 5% for small projects up to 20% for the large and complex projects.

- Contingency amounts are applied as a percentage multiplier to the total estimated construction costs to account for unidentified costs in early estimates. It should be reiterated there is no accepted method for developing contingency percentages by the project managers.

VIRGINIA

What are the major issues you are facing regarding planning or programming cost estimates?

The Virginia Department of Transportation (VDOT) has implemented a new statewide cost estimating system to be used in connection with a good project scoping. The accuracy of the project scope and the corresponding cost estimate are critical to planning and programming budget dollars. Scheduling of the PE (design) phase also presents challenges in keeping projects on track with available funding.

Describe policies, procedures, techniques, and standards used in preparing planning and programming conceptual estimates. If these policies, procedures, techniques, and standards are documented (written), can you provide us with a copy or a website location where we can obtain a copy?

As mentioned above the new statewide estimating system utilizes project features to estimate project costs. The system accounts for roadway design standards and special features as well as the location in the state. These estimates are updated every 90 days from the inception of the project until construction is complete. The system was used exclusively for the first time to develop the FY 2004–2005 6-year plan. Policies and procedures for the system are still under development.

How do you ensure the conceptual estimates reflect all elements of project scope (e.g., related to design, construction administration, construction, right-of-way, environmental, etc.) as defined at the time conceptual estimates are prepared?

The new estimating system accounts for all project cost elements by looking at closed out project cost where all elements are included. The system has a right-of-way and utilities section as well as a section to calculate PE costs.

What types of historical data do you use as a basis for preparing conceptual estimates? How are these data adjusted for time (schedule), location, and other project-specific conditions?

The new estimating system uses historical cost on a statewide basis. These data are then adjusted to account for the project schedule by escalating the construction costs to the proposed advertisement date for the project and for geographical location.

How are contingency amounts incorporated into the estimate? Are contingency amounts based on total estimated cost, identified project risks, or some other variable?

Contingency is included in the estimating model by virtue of the fact that the system looks at closed out project costs. Contingency as a percentage of cost would be used in a system where the estimate is built from the ground up, because in this type of system you may still have omitted items of work, and there is an element of design risk.

WASHINGTON

What are the major issues you are facing regarding planning or programming cost estimates?

- Credibility with the legislature and public (i.e., perception of poor project delivery history).
- Conceptual estimating of mega and nontraditional highway projects, particularly when a program is being developed consisting of numerous megaprojects (i.e., Central Puget Sound Regional Transportation Improvement District).
- Determining the level of risk (contingency) to incorporate in a project budget given line item appropriation climate (e.g., do we budget to accommodate 100% of risk and realize that there will be money left over, or do we budget at 50% risk probability and recognize that we may need to request additional funds?).
- Having confidence in cost estimates that have low level of design.
- Communicating the time value of money and how it affects project costs when projects are delayed. Major impact on right-of-way costs, which generally escalates at a rate faster than inflation. Construction cost escalation is generally closer to the rate of inflation.
- Managing project scope changes.
- Balancing resources for development of project and program level estimates.

At the planning level many of the projects proposed may not receive funding within the 20-year planning horizon. Investing extensive resources into estimating these projects is not a wise investment of limited resources. However, the department is taking some risk that these estimates may be used for budgeting or public communication purposes.

Programming estimates for budget proposals often need to be developed in a very short time period without adequate resources available to perform appropriate analysis.

Describe policies, procedures, techniques, and standards used in preparing planning and programming conceptual estimates. If these policies, procedures, techniques and standards are documented (written), can you provide us with a copy or a website location where we can obtain a copy?

Washington transportation plan and highway system plan are made according to

- Deficiency-based programming
- Prioritization based on benefit–cost ratios, and

- Primary use of parametric estimating.

Cost and risk assessments are performed on most major planning level estimates:

- Cost and schedule range produced.
- Currently 90% used for programming.

The tools used are

- Unit Bid Tabs http://www.wsdot.wa.gov/biz/contaa/uba/ and
- MP3—Benefit–Cost workbook.

How do you ensure that conceptual estimates reflect all elements of project scope (e.g., related to design, construction administration, construction, right-of-way, environmental, etc.) as defined at the time conceptual estimates are prepared?

Scope is verified if the project goes through one of the following processes:

- Cost–risk assessment,
- Value engineering, or
- Comparison to historical project cost data of similar projects and programmatic estimates (cost per lane mile).

Otherwise, scope is verified by means of informal internal verification.

What types of historical data do you use as a basis for preparing conceptual estimates? How are these data adjusted for time (schedule), location and other project-specific conditions?

Either direct unit bid tabulation or parametric estimating is utilized.

Unit bid tabs are

- Updated continuously from recent project advertisement results and
- Based on regional market.

Cost and risk assessments are based on

- Integrated cost and schedule look at project delivery (time value of money incorporated) and
- Subject matter expertise (internal and external experts to the DOT).

Cost data are inflated to current dollars for estimate development using construction cost inflation factors provided by FHWA. Once an assumed schedule for each project is developed, project costs are inflated using the same FHWA construction cost indices.

How are contingency amounts incorporated into the estimate? Are contingency amounts based on total estimated cost, identified project risks, or some other variable?

The Washington State Department of Transportation (WSDOT) uses both traditional estimating and risk-based estimating:

For traditional estimating

- Line item contingency is included. Amount of contingency is based on total estimated cost and historical experience of WSDOT with projects of similar magnitude and scope.
- Contingencies are buried within the estimate (i.e., bumps within unit costs or quantities to cover unexpected needs)

For risk-based estimating

- All contingencies (line item and buried) areremoved.
- Base cost and schedule are identified (base cost and schedule defined as the project cost and schedule that would be delivered if everything went as planned).
- Cost and schedule risks and opportunities are identified and assessed.
- Using critical path methodology and Monte Carlo simulation, base cost and risk-opportunity assessments are combined to produce ranges for expected project cost and schedule with associated probabilities.

WISCONSIN

What are the major issues you are facing regarding planning or programming cost estimates?

The Wisconsin Department of Transportation (WisDOT) is being criticized because the actual construction costs end up being higher than the original planning and program costs. This creates a poor public perception of the department. Planning costs are usually average costs by facility type and are usually expressed in real terms.

Describe policies, procedures, techniques, and standards used in preparing planning and programming conceptual estimates. If these policies, procedures, techniques, and standards are documented (written), can you provide us with a copy or a website location where we can obtain a copy?

The planning procedures for estimating costs are not well documented. Planning-level cost estimates are only briefly explained in the final plan documents and are usually described as average costs by facility type. Also, the estimated costs are usually expressed in real terms, i.e., they don't include inflation.

Programming costs are more refined than the planning costs, since they are specific to a project. They are usually developed after the project has been conceptually defined. However, the project has not been designed nor the real estate purchased, so the costs can still change

significantly. Also, the environmental evaluation has not yet been completed, and it may identify additional costs. Public involvement is another activity that may increase during project development.

How do you ensure that conceptual estimates reflect all elements of project scope (e.g., related to design, construction administration, construction, right-of-way, environmental, etc.) as defined at the time conceptual estimates are prepared?

WisDOT can ensure that all project elements are reflected in the total costs but cannot ensure that additional items will not be added later in project development. Project delivery costs such as design and construction supervision are probably easier to estimate accurately. The project management team determines these costs during scoping of the project. Other costs are difficult to itemize and accurately estimate at the conceptual stage until environmental work, design, and real estate work are completed.

What types of historical data do you use as a basis for preparing conceptual estimates? How are these data adjusted for time (schedule), location, and other project-specific conditions?

Average project delivery and construction costs are used from the most recent projects. The costs are by type of project—resurfacing, reconstruction, capacity additions, etc. Number of bridges, interchanges, bypasses, etc. are part of the estimated total costs.

How are contingency amounts incorporated into the estimate? Are contingency amounts based on total estimated cost, identified project risks, or some other variables?

On the basis of experiences with change orders, etc., contingency costs are included in the estimates at the program level to account for unknown project delivery and construction costs.

APPENDIX B

Responses to Questions on Addressing Safety in Statewide Transportation Plans

CALIFORNIA

To what extent is the framework presented in the NCHRP 8-44 initial draft report relevant to what you are doing in addressing safety in your statewide or metropolitan transportation plan?

California's planning process addresses to some degree all aspects of the framework (using "assessment" questions on page 19 of the initial draft report). Refer to Figure 4 below. The California Transportation Plan (CTP) vision cited on page 20 of the initial draft report is an example of a statewide vision for the transportation system that includes safety. The vision is

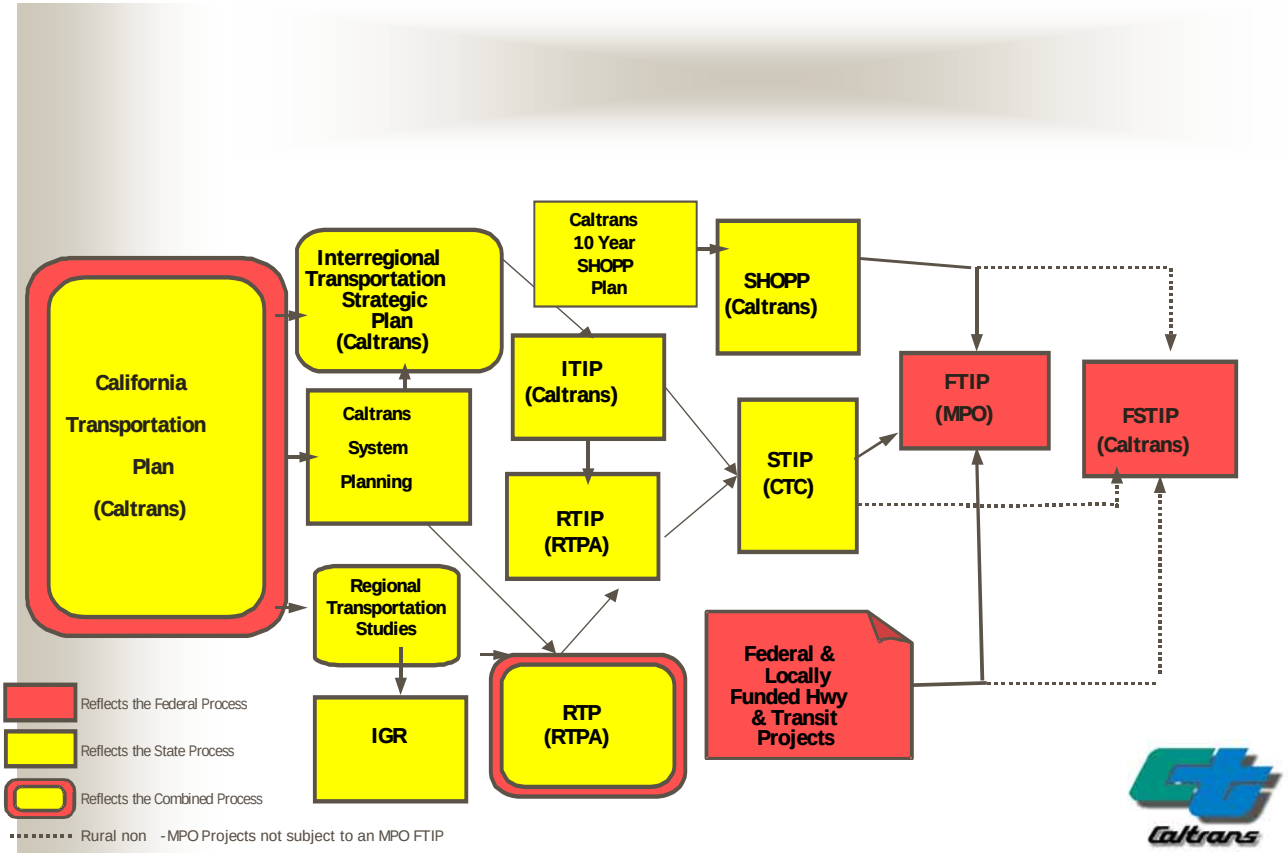

FIGURE 4 California Planning and Funding Process.

California has a safe, sustainable transportation system that is environmentally sound, socially equitable, economically viable, and developed through collaboration; it provides for the mobility and accessibility of people, goods, services, and information through an integrated, multimodal network.

- The CTP has one goal and two policies related to safety:
  - Goal—enhance public safety and security;
  - Policies—improve system and system user safety; provide for system security; and
  - Numerous strategies in support of policies.
- Department strategic plan—safety is the first goal: achieve the best safety record in the nation.
- State's Interregional Transportation Strategic Plan (ITSP)—safety identified as "key outcome" of the transportation system: safety and security–minimizing the risk of death, injury, or property loss.
- SHOPP—10-Year State Highway Operation and Protection Program (2002/03 to 2011/12)
  - Funding for safety and preservation and maintenance of the existing system is taken "off the top" before other needs are funded.
  - The department is committed to reducing the number and severity of accidents.
  - Safety is the first of six categories.
  - Program goal: improve motorist safety by reducing fatal and injury collisions by 12.5% during the 10-year life of this plan.
  - Actions:
    - Safety improvements: investigate all safety locations as identified; those with a Safety Index (SI) greater than 200 will be programmed. (These projects are the department's highest priority).
    - Safety enhancements: implement recommended improvements of the "Run Off the Road" task force—widen shoulders, install guardrails and rumble strips at key locations statewide.
    - Upgrade median barriers: upgrade remaining 175 miles of median barriers that do not meet current federal safety standards.
- IGR/CEQA—Caltrans reviews all planning and development activity (adjacent to or off system) that has the potential to impact highways, and recommends mitigation measures that either eliminate the impacts or reduce them to a level of insignificance. This includes local development impacts that would decrease public safety. The focus of IGR activities is on ensuring that the traveling needs of the public, the safe and efficient access to local land use development, and statewide transportation needs are kept in balance. Caltrans strives to foster consultation with the local lead agency in order to expedite approval of the development and to reduce potential conflicts and misunderstandings that could arise.
- RTP guidelines (see Figure 5).
- STIP guidelines (http://www.dot.ca.gov/hq/transprog/ctcliaison/Delegations/G-03-19.pdf).
- System performance measures and outcomes.

  - System outcome: safety—reduce fatalities, injury, and property loss of system users and workers, facilitate perception of personal safety. Measures—injuries, fatalities, property damage, and collisions—rates and totals.
  - Focus: travel safety and transportation worker safety. Measures—worker fatalities and injuries (rates and totals).

- Key stakeholders and coordination—Pedestrian Safety Task Force; safety project acceleration; SHOPP Executive Committee.

Each Regional Transportation Planning Association (RTPA) should define a set of "program level" transportation system performance measures that reflect the goals and objectives adopted in the RTP. These performance measures are used to evaluate and select plan alternatives. Government Code Section 14530.1(b)(5) requires more detailed project specific "objective criteria for measuring system performance and cost effectiveness of candidate projects" in the STIP Guidelines. The program level performance measures in the RTP set the context for judging the effectiveness of the RTIP, as a program, in furthering the goals and objectives of the RTP, while the STIP Guidelines address performance measurements of specific projects.

Caltrans is considering system performance measurements for interregional planning and the setting of State planning and programming priorities. The State performance measures will focus on interregional trips between, into, and through the regions. Caltrans will coordinate its performance measure activity with the RTPAs.

The California Transportation Plan, Transportation System Performance Measures Report (August 1998) identifies the following, "desired outcomes" for the transportation system, which may be addressed in each region's RTP.

Mobility / Accessibility	Reliability	Cost-Effectiveness
Sustainability	Economic Well Being	Environmental Quality
Safety and Security	Equity	Customer Satisfaction

The RTPA should consider the following in applying performance measurement to the RTP:

- Performance measurement involves examining the performance of the existing system as well as forecasting the performance of the future (planned) system.
- By examining performance of the existing system over time, the RTPA can monitor trends and identify regional transportation needs that may be considered in the RTP.
- Performance measurement has the potential to clarify the link between transportation decisions and eventual outcomes, thereby improving discussion of planning options and communication with the public. This may also help determine which improvements provide the best means for maximizing the system's performance within cost and other constraints.
- Forecasting the future system performance in the context of the RTP should:
  - Assist the RTPA in comparing outcomes of different alternative strategies in developing the plan.
  - Facilitate comparisons across modes and among strategies focused on different modes.
  - Facilitate assessment of priorities in the action element of the RTP, which would link to plan implementation through the RTIP and the ITIP. This will further assist Caltrans to integrate interregional transportation objectives and decisions with regional objectives and decisions.

FIGURE 5 Performance Measurement Guidance from Caltrans RTP Guidebook.[1]

[1] From Caltrans *1999 RTP Guidelines*, pages 9 and D-5.

What are the gaps between what you are doing and what this framework suggests (identified by major areas of framework)?

- Statewide planning—vision, goals, objectives:
  - Ensuring documents (scooping documents, long-range plans, system plans, corridor reports) and related processes focus on safety issues, consideration, and implications and
  - Linking safety to environmental concerns.
- Safety-related performance measure: data inadequate for off-system modes (e.g., bicycles).
- Safety-related data (ID solutions):
  - Identification of data needs and utilization of technology to make readily available,
  - A framework of minimum safety standards by functional class,
  - Research and technical expertise—microsimulation,
  - Integration of data from vehicle event recorders and video surveillance cameras,
  - Safety analysis tools (analyze potential impacts),
  - Methods for predicting crashes and identifying prevention countermeasures and programs, and
  - Safety implications of land use decisions (build out of general plans).
- Evaluation criteria:
  - Evaluation to show what works and helps prioritize programs and projects and
  - Tool to evaluate the cost–benefit return on safety improvements.
- Others:
  - Technologies relating to improving traffic safety devices, collision avoidance systems, and traffic control devices and
  - Driver education programs, including those relating to commercial trucks on our highways, be continued and expanded.

What are the barriers to implementing this framework?

- Fragmented decision-making and responsibilities in developing, programming, and carrying out transportation projects
  - State has overarching responsibility for safety of the system but doesn't control majority of funding.
  - Land-use decisions that result in less than safe street layouts and design and those that affect traffic patterns and intensity but don't include a means to mitigate the effects (for example, approve Centennial but not worry about what happens on a rural two-lane SR-138 5 to 10 miles downstream).
- Lack of generally accepted, quantified "performance measures" or objectives (although we have moved the SHOPP towards attaining quantified goals).
- Lack of good, timely data and analysis (technology needed here).
- Limited funding.

- Caltrans resources are seriously diminished each year by tort liability claims. This can be seen as both a challenge in terms of fewer resources but also an opportunity because it adds weight to any discussion of safety improvements.
- Liability issues—fear of liability claims tends to restrict safety information in public documents.
- Current overloading and overuse of two-lane conventional system and more people and goods on the way (VMT, population, and accidents all increasing).
- More conflicts between large and small mass vehicles due to speed differentials between commercial vehicles and other vehicles, and mostly on congested roads.
- Privacy rights concerns for new technologies that capture driver (and personal) information.
- Significant increases in trade from mainland China and other Pacific Rim nations will continue to cause increases in commercial vehicle travel on our highways and local roads as goods are transported from ship to train to truck to market.
- Competition between SHOPP-type safety projects and STIP projects, including those that may have a safety component.
- Priorities—congestion management trumps safety in most planning discussions.
- Generally planners lack understanding of crash causation factors, and safety engineers are not aware of potential negative interactive affects between land use planning and safety considerations.
- Political and organizational barriers and lack of understanding of safety issues.
- Research and technical expertise.
- Greater human, technical, and financial resources devoted to increasing public awareness of safety integration processes and potential benefits.
- Funding regulations that allow more flexibility and crossover from one source to the other.
- A spirit of partnership and coordination to accomplish safety goals.

What lessons have you learned in addressing safety in your state transportation plan that may be useful to other states?

- The transportation system must be developed as part of a fully multimodal system approach.
- The current planning process is multimodal in nature and incorporates rail, transit, and aviation. While much of the effort focuses on deployment rather than planning, some strong intermodal relationships have been forged, eliminating a need for reinvigoration.
- The long-range planning process involves a wide range of partners and incorporates road user education (road rage and work zone safety), advanced ITS technology, and research to produce innovative solutions.
- The Caltrans districts have performance agreements in line with Caltrans goals and some are pilot testing a State of the District report and establishing performance measures across all modes. They also have collaborative relationships with local planning units. These partnerships provide an opportunity for bringing local units of government into the Regional Transportation Plans.
- Community and other planning grants are available.

- Safe routes to school.
- A Nonmotorized Transportation Steering Committee exists to ensure interchanges are safe for nonmotorized users (e.g., bicyclists and pedestrians).
- A Corridor Safety Improvement Program, involving collaboration among Caltrans, the California Highway Patrol, the Office of Traffic Safety, and local governments. The plan identifies and analyzes corridor safety problems, recommends comprehensive strategies for addressing the safety issues, and evaluates outcomes from safety improvements and programs. These programs are beginning to incorporate commercial vehicle safety issues with assistance from regional freight planning councils.
- SHOPP contains the requisite safety expertise for planning and prioritizing safety projects.
- Encourage the continued development and implementation of in-vehicle collision avoidance systems in both passenger vehicles and trucks that could help to reduce passenger vehicle and truck collisions, injuries, and fatalities.

FLORIDA

To what extent is the framework presented in the NCHRP 8-44 initial draft report relevant to what you are doing in addressing safety in your statewide or metropolitan transportation plan?

The FDOT framework is consistent with the initial draft framework. The following is an example of how Florida integrates safety in transportation planning:

Step 1. Incorporating safety into the vision statement. The FDOT framework is consistent with the draft framework as presented in the NCHRP report. Safety is incorporated into the FDOT mission statement:

> The Department will provide a safe transportation system that ensures the Mobility of people and goods, enhances Economic Prosperity, and Preserves the quality of our environment and communities.

Additionally, the department's vision statement is that "the people of DOT are dedicated to making travel in Florida safer and more efficient."

Step 2. Incorporating safety into the goals and objectives. In Florida, safety is prominent in the Florida Transportation Plan. Moreover, safety is part of all three goals of the agency's Short-Range Component (SRC). The SRC is the annual strategic plan that provides the policy framework for investments in Florida's transportation system.

In addition, FDOT has created a statewide Strategic Highway Safety Plan for providing focus and attention for safety emphasis areas that can be addressed by the department.

By having a strong policy framework inclusive of safety and continuing management support, safety has been incorporated and embraced on a FDOT district and local level. Florida's MPOs and local communities have been a part of the Safety Management System (SMS), Community Traffic Safety Teams (CTSTs), and part of the FDOT decision-making process.

Step 3. Incorporating safety into system performance measures. Florida's transportation plan and short-range component are performance-driven planning documents that have integrated safety into all aspects of transportation. The Department also has 60 legislative performance outcomes and activity measures that track system performance. Generally, safety on a statewide level is currently measured using the following performance measures:

- Bicyclist and pedestrian fatality rates,
- Highway fatality rate (all public roads and state highway system),
- Commercial vehicle crash rates,
- Commercial safety inspections and weighings, and
- Bridge and maintenance condition ratings.

A current challenge for FDOT is finding better bicyclist and pedestrian measures based on quantity and quality of facilities available and also on measuring level of exposure.

Step 4. Incorporating safety into technical analysis. There is a wealth of safety data available in Florida on a statewide basis. Each crash report is entered and is available for analysis. The FDOT receives a copy of these crash reports and applies a location methodology for crashes occurring on the state highway system. All Florida crash reports include those crashes with bicyclists, pedestrians, trucks, and property damage. In addition, contributing causes of these crashes are tracked.

In addition to crash information, Florida has other related databases containing

- Driver's license information,
- Motor vehicle information,
- Emergency medical system reports (for motor vehicle crashes),
- Enforcement data (i.e., DUI (drinking under the influence), safety belt), and
- Vehicle miles traveled (by type of motor vehicle).

Efforts are under way to begin a transition from a milepost tracking system to Geographic Information System (GIS). This will enable compatibility of crash location data for all public roads and roadway characteristics, transit features, bicycle and pedestrian facilities, and other local features and characteristics.

Step 5. Evaluating alternative projects and strategies. FDOT has several initiatives for evaluating and using available information for decision making and prioritizing:

- Florida law (339.177 F.S.) requires that the FDOT have a Safety Management System (SMS). The 4-Es of safety (engineering, enforcement, emergency services, and education) are used. The SMS motto is "Working Together for a Safer Florida!" Community Traffic Safety Teams are a key part of the SMS. Currently 11 SMS subcommittees with representatives from various agencies and organizations focus on specific activities to improve safety. An SMS Steering Committee coordinates the SMS process. The department is planning to modify the SMS based on guidance from the upcoming federal legislation and reauthorization process. The SMS process includes a traffic records subcommittee that includes representation from other safety related agencies.

- Safety is considered in the development of the Plans Preparation Manual (PPM), which guides the development of all projects. The Design Office uses crash data and analysis to modify the PPM. Recently, for example, safety analysis was used to develop a new suburban section for the PPM with a new wider than urban safety clear zone.
- The State Safety Office coordinates safety in the department. Each district has a safety engineer to coordinate district-level activities and collaborate with local governments.
- The Strategic Highway Safety Plan outlines five safety focus areas to be addressed over the next 5 years. The focus areas are vehicle travel lanes, intersections, access management and conflict points, information and decision support systems, and bicyclist and pedestrian safety.
- The department is continuing development of GIS capabilities including the new Crash Analysis Reporting System (CARS) being able to plot crash data on GIS mapping layers, including roadway features. Also, a bicycle and pedestrian GIS crash mapping training program has been established for local analysis.
- Florida Community Traffic Safety Teams are in most counties with 59 teams statewide. The program started in 1994 to bring local stakeholders into the decision-making process. Some districts have full-time coordinators.

What are the gaps between what you are doing and what this framework suggests?

No significant gaps exist from what is proposed on the state level.

What are some of the barriers to implementing this framework?

- Cultural and practice changes are needed to elevate safety considerations into design, construction, and maintenance areas. This is a continuous process and not a short-term initiative.
- Ensuring that safety considerations are in balance with capacity improvements.
- Establishing compatibility in crash location and analysis methods, e.g., milepost vs. GPS location methods.

What lessons have you learned in addressing safety in your state transportation plan that may be useful to other states?

- Safety should be supported at the highest level and should not be a stand-alone goal. Safety should be in all aspects of planning and should be addressed broadly.
- Multimodal safety and exposure data are becoming more important.
- Results don’t happen quickly; they take time, continued management support, accurate and accessible data, and performance measurement.

MICHIGAN

To what extent is the framework presented in the NCHRP 8-44 initial draft report relevant to what you are doing in addressing safety in your statewide or metropolitan transportation plan?

As outlined, the framework closely mirrors the MDOT's planning process. The following outlines some of the safety planning, implementation, and evaluation activities that are incorporated into MDOT's planning process.

Mobility Is Security: State Long Range Plan 2000–2025

Mobility Is Security is a transportation planning document that includes goals and objectives for all transportation modes, baseline infrastructure information, and strategies for achieving plan goals. The document reflects input from numerous public involvement meetings, including meetings of the specialized Customers and Providers Advisory Committee. The plan provides a framework for investment in Michigan's transportation system for the years 2000 to 2025. The investments you trust us to make must preserve the system, but make sure that it operates efficiently, effectively, and safely. Michigan residents recognize the importance of secure transportation to every aspect of their lives, and this plan is designed to preserve the high degree of mobility and security we currently enjoy.

Safety is incorporated as a distinct goal, rather than being incorporated into other goals as an ever-present concern. MDOT's Safety Goal states: "Promote the safety and security of the transportation system for users and passengers, pedestrians and motorized and nonmotorized vehicles."

The following long-range plan objectives support MDOT's safety goal:

- Continually reduce the rate and severity of motor vehicle crashes through research, innovation, and application in partnership with other traffic safety organizations and professionals.
- Participate in educational efforts and public information campaigns to educate vehicle operators and other users of transportation systems to become safer road users, passengers, and pedestrians.
- Recognize the differing demands of the many modes using the road network, and improve the safety of different kinds of traffic using the same networks, such as automobile and truck traffic, vehicles and pedestrians or bicycles, or road and off-road vehicles, including snowmobiles.
- Continually implement infrastructure improvements and security procedures that safeguard the welfare of those using various components of the transportation system, such as airports and air services, bridge, railroad and vessel border crossings, and railroads and rail services for the transport of people, services, and goods.
- Work with local communities and railroads to improve safety and traffic flow at points where transportation networks intersect, such as at rail–highway grade crossings; non-motorized paths, routes and trail crossings; and bridges and overpasses.
- Promote safety through adherence to sound engineering practices and uniform, high standards in traffic signs, signals, and pavement markings on state and local road systems.

- Promote high professional standards among those responsible for traffic engineering, crash prevention, and enforcement through qualification and periodic in-service training.
- Work with service providers, local communities, and enforcement officials to improve the user safety of transit and intercity buses and trains, and the security at bus stops, carpool parking lots, stations, and rest areas.
- Work to identify and address the needs of aging drivers and pedestrians, the visually and physically impaired, and other groups with distinct safety needs.
- Ensure that the planning process considers the safety of community residents as it plans, develops, designs, and implements transportation and land use actions.

Performance indicators and measures have been incorporated into MDOT's Transportation Management Systems, MDOT's multimodal database. This allows compilation of the performance measures values at any given time to monitor and evaluate our transportation system and track progress of achieving our goals. In selecting the indicator or goal, we focused on areas where reliable information is already collected on a regular basis or can be obtained at reasonable cost. From a safety perspective, we monitor such things as the number of accidents per 100 million vehicle miles traveled per year, accident rates, rail-grade crossing property damage and facility crashes, and other crash rates and trends.

MDOT Traffic and Safety Division

The institutional responsibilities for managing safety activities are handled by the MDOT Traffic & Safety Division. Their mission is to serve the public's transportation needs through the application of comprehensive highway traffic engineering technology, participating in all phases of the department's effort to reduce traffic crashes and injuries, vehicle delays, fuel consumption, pollution, and operating costs by increasing the safety, efficiency, and capacity of the state highway trunkline system. The major responsibilities of the work area are to

- Respond to traffic engineering requests;
- Determine the need for traffic control devices;
- Administer traffic operations and safety programs;
- Plan, design, implement, and maintain a traffic engineering data records system;
- Study driver behavior, vehicular capabilities, and interactions;
- Provide engineering support for litigation against MDOT; and
- Respond to freedom of information (FOI) requests.

Governor's Traffic Safety Advisory Commission (GTSAC)

In 1941, the Michigan State Safety Commission (MSSC) was legislatively established to promote greater traffic safety on public roadways. The commission, through interagency cooperation, was committed to reducing traffic crashes, injuries, and deaths in Michigan by promoting effective safety programs. The MSSC was comprised of representatives from the Departments of Community Health, Education, State Police, State, and Transportation.

The Michigan Traffic Safety Management System (MTSMS) is a process that began in 1995 for coordination of the state's highway safety efforts. The goal of the MTSMS was to reduce traffic crashes and their resulting deaths and injuries. As its foundation, the MTSMS

relied on the strengths of coordinated and cooperative efforts of state, local, and federal agencies in conjunction with private safety partners.

It became increasingly apparent that the coordination and role of the MTSMS was similar to the MSSC, resulting in confusion and a lack of a clear focus on traffic safety goals. As a result, the GTSAC was established in May 2002 to provide leadership in the identification of state and local traffic safety issues and promote recommended strategies to address them. The agencies of Michigan state government that comprise the GTSAC are Community Health, Education, Secretary of State, State Police, Transportation, Office of Services to the Aging, Office of Highway Safety Planning, and the Office of the Governor. There are also local agency representatives.

One of the first steps taken for this newly formed organization was to enhance communication among the membership via e-mail using a LISTSERV developed by OHSP. A LISTSERV works like a group mailing, going to all users who subscribe to it by e-mail. This system will notify members of traffic safety meeting dates, provide meeting agendas, and keep the group up-to-date on the latest traffic safety information.

The GTSAC has a number of task teams working on a variety of safety issues. The Traffic Records Coordinating Committee (TRCC), one of the task teams of the GTSAC, serves the GTSAC by addressing specific issues relating to crash data. The TRCC's work plan addresses traffic challenges that detail goals and objectives that align with the direction of the GTSAC:

- Police traffic services. The Drive Michigan Safely Task Force is an umbrella program for the Click It or Ticket and You Drink & Drive: You Lose campaigns.
- Safety belts. The Michigan goal is to have 90% of Michigan motorists buckling up by 2004. Two of the major statewide campaigns are Buckle Up or Pay U and Click It or Ticket.
- Safe communities. Safe Communities is a nationwide program. There are currently 22 Safe Communities in Michigan.
- Youth alcohol programs. The Michigan Coalition to Reduce Underage Drinking (MCRUD) provides funding and support to local coalitions.
- Driver issues and education
- An Elderly Mobility Action—Graduated Licensing Law (GDL).
- Michigan Traffic Safety Fundamentals Handbook (MTSFH). Consistent with federal initiatives to improve safety, Michigan is pushing to reduce crashes over the next 10 years. Achieving these crash reduction goals requires initiatives in each of the four primary disciplines of traffic safety. A key first step involves focusing attention on improving safety education, increasing the level of knowledge about the basic causes of crashes, and reinforcing the link between highway design decisions and safety. The MTSFH supports these efforts by being a resource to and for all traffic safety partners. This handbook is divided into five sections: Crash Statistics, Identification of Hazardous Locations, Traffic Engineering Toolbox, Lessons Learned, and Traffic Safety Resources.
- Other priorities. Promoting "Walkable/Bikeable Communities" and the Network of Employers for Traffic Safety (NETS) programs and providing public information on distracted and drowsy driving.

Safety Conscious Planning (SCP) Forums and Program Integration

Each MPO is developing a safety profile and will hold a safety forum as a starting point for integrating safety-conscious planning into the metropolitan planning process. The short-term objective is to integrate safety considerations into the transportation planning processes at all levels, such as the Transportation Improvement Plans developed by the MPOs. As a long-term objective, the consideration of safety objectives will be incorporated into the 20-year plans that the MPOs are required to prepare and periodically to update. The forums are set up to include key traffic safety partners within the community to review how safety can provide the following benefits:

- Increase awareness of safety within the community,
- Save lives, reduce injuries and crashes,
- Create a more comprehensive community safety plan,
- Improve the ability to analyze data and predict outcomes, and
- Decrease overall transportation expenses.

This fall we are starting this same effort among MDOT, FHWA, and the Michigan Regional Planning Organizations for our rural areas beginning with two multicounty rural areas. Phase Two involves the identification of the best method for areawide integration:

- Attend a 1-day training seminar on the systematic and organized approach to safety conscious planning.
- Hold member agency workshops to identify goals and performance measures.
- Develop the process and a timetable for integrating the goals and performance measures into the project identification and selection process.
- Determine how to integrate SCP into the overall transportation plan.
- Adopt SCP language in transportation-related documents.
- Create a communication plan explaining why SCP is important and how the community will benefit from SCP.
- Develop a method to identify priority projects and issues.
- Provide a feedback mechanism to gauge the effect and effectiveness of SCP and to identify improvement opportunities.
- Review current and future projects to determine if safety has been incorporated into the overall plan.

Transportation Summit

To build on a foundation of partnership and assure Michigan's continued success, MDOT hosted a Transportation Summit in late 2003. The focus of the Transportation Summit was to determine our collective vision for transportation in Michigan.

Transportation industry partners, citizens, members of the legislature, academia, and the federal government were invited to help MDOT create a vision and a set of action plans for the future of transportation in Michigan. The process began with planning meetings that started in the summer and autumn of 2003 and culminated with the summit conference in December. After

the summit, a series of ongoing action team meetings are being conducted to implement the new vision. Michigan's vision is as follows:

> Michigan will lead the 21st century transportation revolution as it led innovation in the 20th century. We will move people and goods with a safe, integrated, and efficient transportation system that embraces all modes, is equitably and adequately funded, and socially and environmentally responsible. Michigan's transportation community will work together to ensure that resources are in place to deliver the system.

The Safety Summit Action Team is charged with developing an action plan for the issues, goals, and actions identified at the summit as listed below.

Issues

- The greatest gains in further reducing fatalities are to be had through enforcement and improved and systemized driver education.
- Affecting transportation system user behavior will have one of the biggest impacts on reducing fatalities in Michigan.
- Data collection and reporting and accuracy of data must be improved.

Goals

- Accurate and up-to-date and accessible accident information for all modes of transportation must remain a high priority and is the key to having the tools to reduce fatalities in Michigan.
- Safety will be incorporated as a priority in every phase of project design and planning stages.
- Education and resources will be coordinated among local, county, and state agencies and nongovernment groups.

Actions

- Provide information and education for road authorities regarding low cost–high benefit safety improvements.
- Expand and enhance partnerships of all transportation stakeholders to find ways to use technology to reduce crashes.
- Continue education for drivers and nondrivers beyond initial license requirements and increase enforcement.
- Define and improve data collection.

A draft implementation plan has been developed and is still under review by the action team members. Many of the items identified during the summit are in operation or under development, which underscores the need for a solid communication program.

Tools

Safety Management System As one of six components of the Transportation Management System (TMS), the Safety Management System (SMS) is the decision-support tool responsible for analyzing vehicular crashes and the roads on which they occur. It supports an overall goal of the MDOT to provide the safest public roadway infrastructure through combined use of people, technology, and analysis.

SMS particularly provides for identification, analysis, and implementation of engineering improvements at high-crash locations. Annually, this allows effective management of millions of federal dollars used in road safety improvement projects.

SMS includes elements necessary to support the process of ensuring that safety-based improvement opportunities are identified, evaluated, and implemented. Perhaps more than any other tool, safety management requires direct partnership with our federal, state, county, local, and private safety partners, each of whom is responsible for various safety issues. MDOT staff uses SMS as a tool for coordination of the responsibilities of all partners in safety, particularly related to engineering and planning for the road assets for which the state is responsible. The application also provides data used in long-term corridor improvement planning.

Crash Process Redesign A significant change in the state's crash reporting system now allows law enforcement agencies unprecedented up-to-date access to local information. The Crash Redesign Project (CPR) is a multiagency initiative by the Departments of State Police, State, Transportation, and Information Technology to redesign and upgrade the state's traffic crash processing system. Improvements include streamlined data processing, improved coordination and sharing of crash data among state agencies, the ability of web-based reporting for law enforcement agencies, reduced processing costs, improved quality of crash data, and certifies the ability for agencies to electronically submit crash forms.

Law Enforcement Agency Management System The Law Enforcement Agency Management System (LEAMS) project is a state-of-the-art law enforcement agency management system. The Department of State Police has worked with local law enforcement agencies to develop the requirements for this new system. LEAMS will take full advantage of the latest technology. It is being developed to include at least incident reporting, crash reporting, citations, intelligence reporting, and activity reporting modules. The browser-based system will also be able to transmit data over the upgraded Michigan Public Safety Commission's 800-MHz radio system. Since open architecture will be used, it will provide the opportunity to integrate with many other records management systems, so information can be shared, allowing the criminal justice community to be more efficient and effective in solving crimes.

Strategic Transportation Safety Plan MDOT is developing a Strategic Transportation Safety Plan with emphasis areas and guidance documents that will be made available on completion.

What are the gaps between what you are doing and what this framework suggests?

- Incorporating safety planning tools. We have the SMS and CRIS but are not sure what else is being used in the regions and TSCs.
- Evaluation criteria.

- Documentation of the different safety-related evaluation methods currently in use between the state, MPOs, and other agencies.
- We have sophisticated processes for after-studies and monitoring at the project level but not at the program level.
- Lack of a safety analysis forecasting tool that allows us to forecast systemwide benefits and the consequences of varying investment levels.

What are the barriers to implementing this framework?

- Unwillingness to "predict or forecast" future safety characteristics (e.g., crashes)—liability risks.
- Data analysis capabilities—resources, knowledge, etc. The behavioral safety programs are organizationally and institutionally separate from the infrastructure safety programs at both the state and local levels. Although we have made great forward strides regarding coordination, we still have a way to go to merge the two aspects of safety planning.
- Time and money play an integral role in our ability to implement the framework. It has cost a substantial amount of money to keep the crash data current.

What lessons have you learned in addressing safety in your state transportation plan that may be useful to other states?

It is important that agencies include safety partners such as Mothers Against Drunk Driving, Students Against Drunk Driving, traffic improvement associations, and Offices of Safety Planning very early in their plan development processes.

It was difficult to get the MPOs to take that first step toward introducing the Safety Conscious Planning Process and Forums to the community. They thoroughly understood the need and were very interested in the concept. However, without specific guidance they were reluctant to take the first step. Once one of the MPOs held a forum and reported on how receptive the participants were, the rest of the MPOs started the development process and conducted their forums.

For additional information, please contact

Marshal L. Small, Manager
Statewide Planning Section, MDOT
517-373-9054
smallm@michigan.gov

Susan Gorski, Manager
Statewide & Urban Travel Analysis Section
MDOT
517-335-2958
gorskis@michigan.gov

MINNESOTA

To what extent is the framework presented in the NCHRP 8-44 initial draft report relevant to what you are doing in addressing safety in your statewide or metropolitan transportation plan?

The framework is very relevant. MnDOT has and is addressing safety through each step of the framework.

Vision

The statewide transportation plan has established safety as one of 10 key policies, along with system preservation, statewide mobility, mobility within major trade centers, etc. The plan supports the vision of Toward Zero Deaths.

Goals and Objectives

These are stated in the *Statewide Transportation Plan*—Policy 7: Increase the Safety and Security of Transportation Systems and Their Users.

Performance Measure and Targets

The following safety-related measures and targets are included in the statewide transportation plan:

- Annual crash rate—highways, passenger service, freight (on state trunk highways);
  - Target—crashes per MVM (million vehicle mile) 3-year moving average
    - 2009 0.96
    - 2013 0.88
    - 2023 0.73
- Total crashes—general aviation
  - Target—total general aviation crashes 3-year moving average
    - 2009 35
    - 2013 32
    - 2023 30
- Total crashes—at-grade rail crossings
  - Target—at-grade rail crashes 3-year moving average
    - 2009 46
    - 2013 34
    - 2023 15
- Total fatalities—highways, passenger service and freight
  - Target(moderate/aggressive)—annual roadway-related fatalities 3-year average
    - 2009 606/590
    - 2013 604/580
    - 2023 600/550

- Total fatalities—general aviation
  - Target—general aviation fatalities 3-year moving average
    - 2009 7
    - 2013 7
    - 2023 6

Analysis

Crash data are collected by the Department of Public Safety and analyzed by the department and MnDOT to assess the distribution of various contributing factors, including age, gender, alcohol use, seat belt use, road design, crash type, etc.

Evaluation

Data analysis leads to evaluation and may lead to a variety of programs:

- Education—buckle-up advertising campaign.
- Enforcement—July 4 sobriety saturation by state troopers.
- Engineering—MnDOT has identified its top 200 high crash intersections and road segments. Targets funds to address those that are deemed "correctible." Use B/C (benefit/cost) to rank projects.

Products

MnDOT addresses safety in a variety of products including the statewide transportation plan, district plans, STIP investment targets (40 high-crash intersections/segments per year), projects, road safety audits, etc. MnDOT is supporting Department of Public Safety's Toward Zero Deaths initiative. MnDOT is now developing a Comprehensive Highway Safety Plan in conjunction with the Department of Public Safety and other partners.

System Monitoring

MnDOT provides regular, scheduled reporting on its safety measures to the commissioner and senior management. MnDOT is working to refine its approach to reporting to emphasize types of roads, causes, and populations affected as opposed to just general crash rate and total fatalities.

What are the gaps between what you are doing and what this framework suggests?

Not too many gaps exist. One issue that arose during the statewide transportation plan public involvement is that the public did not generally consider highway safety to be an issue. The public did not express concern about the 600+ fatalities in Minnesota each year. MnDOT probably needs to conduct more market research to discover the public's perceptions and identify the focus of education and awareness efforts.

What are the barriers to implementing this framework?

Public apathy, cited above, means that the legislature is not particularly interested in stricter rules (e.g., mandatory seat belts, graduated license, greater enforcement). During the past session, the legislature barely passed the .08 alcohol provision and introduced bills to increase speed limits on two-lane highways.

MnDOT also sees a need for better research to establish criteria for cost-effective application of various roadway design improvements. With limited funding availability, MnDOT needs to identify high impact investments.

Crash data are not as accurate as we would like. The Department of Public Safety has also had problems maintaining its database because of budget problems, which has serious implications for all our efforts, both long- and short-term.

What lessons have you learned in addressing safety in your state transportation plan that may be useful to other states?

- It is essential that various public agencies and private organizations work together.
- We really need to understand public perception of highway safety issues if we are going to make headway on our Toward Zero Deaths initiative.

MISSOURI

To what extent is the framework presented in the NCHRP 8-44 initial draft report relevant to what you are doing in addressing safety in your statewide or metropolitan transportation plan?

MoDOT and the MPOs are using a process similar to the framework presented in the NCHRP 8-44 initial draft report. Missouri has worked over the past several years to establish strategies and performance measures. The department's dashboard has two measures related to safety at this time. The commission and top management review these measures on a regular basis.

Our Transportation Management System allows MoDOT staff to look at various layers of data that include crashes (by type, severity, condition, etc.); roadway and bridge condition (rutting, roughness, etc.); and volumes (cars, trucks, etc.). Through our GIS system, crashes can be analyzed in relationship to the other system conditions.

Before last year the Highway Patrol had a separate crash database. This caused problems in reporting because of the two separate databases. Over the past year we have established a common database at MoDOT, and both agencies report from this one source. Safety is emphasized in all of the projects in Missouri. Projects are prioritized and developed with the safety aspects identified and considered.

Two years ago the governor moved highway safety into MoDOT. This created a division with an emphasis on strategies beyond just engineering. This has enabled us to pull together the engineering, education, enforcement, and emergency agencies, and develop *Missouri's Blueprint for Safer Roadways*. This is the first step in developing Missouri's comprehensive safety plan.

In addition to liaison with the MPOs, we are also working with our 19 regional planning commissions. These organizations help develop our project priorities based on the process in our

planning framework. This framework outlines how MoDOT works with these various organizations from needs identification through project scoping to programming.

What are the gaps between what you are doing and what this framework suggests?

Our current gap is the institutionalization of the comprehensive safety plan. This is not just engineering and will require some change within MoDOT. Another is the understanding of how this comprehensive safety plan fits with the LRTP. These two plans need to be integrated.

What are the barriers to implementing this framework?

There are no barriers with top management. The biggest issue is education. We have all of the pieces of the framework, but not many people understand the overall concept or even the need for the linkages.

What lessons have you learned in addressing safety in your state transportation plan that may be useful to other states?

MoDOT has learned to get all of the right agencies involved and that we need to look at the big picture. What might have been a high priority for highway safety in the field of behavioral safety programs was not necessarily the top priority when looking at fatalities from an engineering standpoint. Both are important, but one may be easier to affect than the other. For that reason, it makes good sense to put your money and efforts, if possible, into the countermeasure that will save the most lives overall. By affecting one (run off the road), we are quite possibly affecting the other at the same time (drunk driving crashes). Several issues overlap each other so we are never really starting at the beginning with our efforts.

We also learned that by developing the *Blueprint* there is a place for nearly everyone to collaborate if they choose to.

MONTANA

To what extent is the framework presented in the NCHRP 8-44 initial draft report relevant to what you are doing in addressing safety in your statewide or metropolitan transportation plan?

MDT's planning processes closely resemble the framework presented in the NCHRP 8-44 report. The specific items follow.

Vision Statement

MDT's planning process doesn't have a vision statement. Rather, our department mission statement is as follows:

> MDT's mission is to serve the public by providing a transportation system and services that emphasize quality, safety, cost effectiveness, economic vitality, and sensitivity to the environment.

Statewide Planning Document

MDT's *TranPlan21* includes two policy goals for traveler safety:

- Reduce the number and severity of traffic crashes on Montana's roadways and
- Provide leadership and coordinate with other Montana agencies to improve traveler safety.

Performance Measures

Each policy goal has multiple performance measures that are used to guide MDT's planning process. Additionally, the MDT strategic business plan customer quadrant includes a goal to "reduce fatal and injury crash rates." This strategic goal is used as a building block for the department's performance goals and measures.

Safety-Related Data

MDT uses safety-related data to identify and address problem areas on the state's highway system. There are some gaps in the data availability.

Project and Strategy Evaluation Criteria

MDT's performance programming process uses inputs from our safety management system in developing the department's work type and funding program.

Planning Actions That Focus on Safety

As mentioned above, MDT's statewide plan includes policy goals for traveler safety. For the measure of these goals, there are 11 action items. These actions range from the monitoring and evaluation of animal and vehicle crash mitigation research methods to implementing access management plans to conducting a study of pedestrian safety conditions and needs.

Prioritization Scheme to Develop a Course of Action for the Agency

MDT's performance programming process is the mechanism that determines the program and funding mix necessary to make the best use of the funding available and provide the best possible transportation system. Input form MDT's safety management system is a consideration in the performance programming process.

What are the gaps between what you are doing and what this framework suggests?

Jurisdictional boundaries create a significant gap in the implementation of a comprehensive statewide safety plan. In Montana, jurisdictional authority for enforcement, education, and project development often exists in different agencies. Each of these agencies has their own goals, processes, and funding constraints. Coordination between the agencies to develop a common direction is difficult. In addition to state agency boundaries, Montana also faces jurisdictional issues with tribal governments. It is difficult to obtain data for accidents that occur on the reservations.

What are the barriers to implementing this framework?

- As mentioned above, developing a comprehensive safety plan is hindered by the nature of government structure and jurisdictional boundaries.
- There are always more safety needs than there are resources available.
- It is often difficult to find direct causal links between accidents, the causes, and the appropriate action to reduce future accidents. These issues must be identified to select the projects that will maximize the safety benefits.

What lessons have you learned in addressing safety in your state transportation plan that may be useful to other states?

Interagency and multijurisdictional coordination is essential for success. MDT has initiated a coordinated planning process to further our ability in developing a comprehensive safety plan. Though MDT has taken the steps to initiate this process, we are still learning.

OHIO

To what extent is the framework presented in the NCHRP 8-44 initial draft report relevant to what you are doing in addressing safety in your statewide or metropolitan transportation plan?

At the statewide level, the framework presented is very consistent with ODOT's treatment of safety in its statewide transportation plan. We are in the early stages of community-based planning; at this time the program is not entirely developed. We plan to work with MPOs to facilitate the development of their safety programs. The department's objective is to encourage MPOs to address safety as an independent issue.

What are the gaps between what you are doing and what this framework suggests?

Currently there are no gaps between our plans and the proposed framework.

What are the barriers to implementing this framework?

Data limitation is a significant barrier to implementation. ODOT is concerned that the spatial accuracy of crash data is insufficient, and further, there is currently a 4 to 6 month lag period before the release of spatial data (see Appendix C).

It is difficult to attain seamless communication and coordination among all interested agencies and individuals.

Lack of adequate funding is continually a barrier to the implementation of safety and other programs.

What lessons have you learned in addressing safety in your state transportation plan that may be useful to other states?

ODOT developed the new Highway Safety Program that dually addresses safety and congestion. By layering congestion locations on the rural and urban system with high-crash locations statewide, ODOT discovered direct correlations between congested locations and high-crash locations. These high-crash, congested locations are identified as hot spots. This discovery led to the development of the New Highway Safety Program, under which the department focuses resources on target-rich locations, with the ultimate goal of reducing the number of crashes statewide by nearly 50% (see Appendix C).

Low-cost, short-term countermeasures can be tracked monthly to identify best-practice countermeasures for mitigating crashes and congestion (see Appendix C).

Automate the countermeasure evaluation section of the workplan once a countermeasure is complete.

Develop a web-based work plan that districts can enter and use to obtain necessary information.

PENNSYLVANIA

To what extent is the framework presented in the NCHRP 8-44 initial draft report relevant to what you are doing in addressing safety in your statewide or metropolitan transportation plan?

The framework is very much relevant. PennDOT is always trying to get our planning partners more involved with highway safety. PennDOT is currently in the beginning stages of the process of forming Pennsylvania's Comprehensive Strategic Highway Safety Plan (CSHSIP) using the Integrated Safety Management Process (ISMP), which should incorporate much of what is presented in the initial draft report (involving other agencies, planning partners, etc.). This plan is not yet set up, but PennDOT wants to head in the right direction.

What are the gaps between what you are doing and what this framework suggests?

- We need to incorporate safety into planning at the local and regional levels.
- PennDOT needs to work more closely with metropolitan and rural planning organizations on specific safety project identification, prioritization, and programming.

What are the barriers to implementing this framework?

These are

- Competing priorities for limited funding;
- Federal obligation levels, which are less than apportionments; and
- Buy-in by all stakeholders.

What lessons have you learned in addressing safety in your state transportation plan that may be useful to other states?

- It is difficult to reach the safety goals and improve highway safety without buy-in from metropolitan and rural planning organizations to prioritize and program safety projects.
- If safety goals and accountability are established for the metropolitan and rural planning organizations, they might be more receptive to incorporating safety into the planning process.

UTAH

To what extent is the framework presented in the NCHRP 8-44 initial draft report relevant to what you are doing in addressing safety in your statewide or metropolitan transportation plan?

Safety is addressed in the statewide long-range plan in the same manner as outlined by this report starting with the vision, goals, and objectives and following up with performance measures, data analysis, and evaluation and monitoring. Safety is a primary factor in prioritizing projects. Most of this information comes to us from the safety division as a result of a comprehensive safety plan for the state. In order to achieve the desired goals and objectives, UDOT has established a safety leadership team and adopted six strategic safety programs:

- Signal Program,
- Roadway Safety Improvement Program,
- Safety Spot Improvement Program,
- Work Zone Safety Program,
- Pedestrian Program, and
- School Zone Safety Program.

What are the gaps between what you are doing and what this framework suggests?

The framework does not make the distinction as to what activities are the responsibility of planning and which belong to the safety program. As for our program, there is some concern as to how well the MPOs are able to approach this same subject with a similar effort. Safety projects are typically more of a short-term or immediate nature, and long-range safety projects are more difficult to identify. We have a gap in including education and enforcement as part of

the planning effort and in developing an evaluation process that can measure the benefits of one safety project against other projects.

What are the barriers to implementing this framework?

These include

- Identifying the scale of some of the safety problems that may be regional or corridor based.
- Including safety data for other modes of transportation.
- Fatality and crash reductions are good goals but additional analysis of the cost to society would be more helpful and meaningful to others.

What lessons have you learned in addressing safety in your state transportation plan that may be useful to other states?

By identifying safety as a principal goal with established performance measures, UDOT created public interest and participation in the long-range planning process that would not have been there otherwise. Once safety is established as a priority it is surprising how many more projects stress the safety element in the purpose and need for their project.

VERMONT

To what extent is the framework presented in the NCHRP 8-44 initial draft report relevant to what you are doing in addressing safety in your statewide or metropolitan transportation plan?

Most of the suggested process has been used to develop the Safety Management System Phase I Study (SMS), prepared May 2001. The *Vermont Long-Range Transportation Plan*, dated January 2002, mission and vision statement recognizes safety as a vital component of our mission; the LRTP public survey indicated that 72% of the surveyed public considers safety to be the number one transportation concern; and the plan recommends that the Vermont Agency of Transportation continue to develop and use tools such as the SMS to "encourage and promote a safe transportation system."

What are the gaps between what you are doing and what this framework suggests?

In the small portion of the SMS plan that has been implemented, correspondingly little of the framework suggestions are in place. Consequently, the gaps are significant.

What are the barriers to implement this framework?

These are

- Funding for staff, consultants, and operating costs to implement the plan and

- Lack of management commitment to implementing the plan, except for small parts.

What lessons have you learned in addressing safety in your state transportation plan that may be useful to other states?

[No response provided.]

WASHINGTON

To what extent is the framework presented in the NCHRP 8-44 initial draft report relevant to what you are doing in addressing safety in your statewide or metropolitan transportation plan?

As a first point, WSDOT found the guidebook to be an easy read and clear, well organized, and easy to follow, compared to many transportation guidebooks that are overly complex and are hard to use.

Since WSDOT has a comprehensive statewide safety plan that is integrated with statewide transportation planning, the framework presented in the report reinforces the approach that WSDOT has developed but does not provide a lot of new concepts. For states that haven't been engaged in safety planning, the report does provide a good outline to follow and provides good questions and tools to develop the detail needed in this planning process.

While the guide starts with some discussion about overall transportation safety, it quickly shifts in the rest of the discussion to roadway safety and the data, analysis, and performance measurement and prioritization methods for roads. Perhaps more attention should have been given to the safety concerns of other modes.

What are the gaps between what you are doing and what this framework suggests?

In general, WSDOT is following the general framework. One comment on the report's framework is that it starts with a vision and goal setting, and then proceeds to recommend collecting data on the elements of that vision. While this might be a bit of a chicken and egg argument, WSDOT believes that data collection is a fundamental starting point, and that good data can and should help shape the planning vision. Data are an important diagnostic tool that should be used in developing visions and goals.

The framework also suggests talking to modelers about how to forecast safety issues. This is a good recommendation and one that is not done on a regular basis in the planning process. This is especially challenging to accomplish with the driver-behavior aspects of safety. WSDOT does model safety performance on projects.

What are the barriers to implementing this framework?

Some state DOTs seem to have a barrier to embracing behavioral strategies. For this framework to be successful, both behavioral and roadway approaches need to be treated fairly and adequately included.

What lessons have you learned in addressing safety in your state transportation plan that may be useful to other states?

Safety needs to be a stand-alone focus in the plan. While safety concerns are integrated into all projects and activities that are recommended in the plan, separate treatment helps identify the extent of the problem and how the safety problems differ across regions of the state, across portions of the system, and across transportation modes. This focus also assists in making the case for investment specifically in safety rather than other investment that is built to safety standards.

Data are critical. Good safety data are needed to diagnose the various safety problems that exist, to put the various problems in perspective, and to help in prioritizing investment needs.

All transportation modes should be included in the analysis. WSDOT found that highway (including pedestrian and bicycle) accidents were the predominant problem from a death and disabling injury perspective, but it is useful to identify safety concerns in other modes. It puts the highway problem in perspective but also provides a safety emphasis for each modal investment program. For example, the number of general aviation crashes is fairly small compared to the total state crash numbers, but safety is an important element of our small general aviation support program. The state plan needs to fairly identify all of the safety concerns so that programs can then act on them.

It is essential to incorporate both behavioral approaches along with roadway approaches in a strategy. The end result desired is safety for the transportation customer, and that should be done by focusing resources where they will do the most good. Sometimes, a roadway investment approach can do little to solve a safety problem (such as with impaired driving). Behavioral approaches such as enforcement and education need to be given equal consideration both in identifying solutions, and in investing limited funding.

It is important to have an effective partnership with the state's highway traffic safety group. This group usually specializes in behavioral approaches, and it brings an important buy-in to the plan by the other safety advocates including the State Patrol, local law enforcement, the Department of Health, and others.

Don't shy away from a "target zero" goal. This type of goal can really get an agency out of a "business as usual" mindset, and gets people thinking of new and innovative ways of attacking the problem.

WISCONSIN

To what extent is the framework presented in the NCHRP 8-44 initial draft report relevant to what you are doing in addressing safety in your statewide or metropolitan transportation plan?

WisDOT's statewide and metropolitan plans essentially follow the same process: vision, goals, performance measures, data analysis, evaluation, monitoring, etc.

What are the gaps between what you are doing and what this framework suggests?

Wisconsin's smaller MPOs still need to incorporate the complete process into their metropolitan planning process. Currently, the MPOs don't identify, locate, or analyze crash rates.

WisDOT produces both a Strategic Highway Safety Plan and a Statewide Long Range Transportation Plan. In the department's Strategic Highway Safety Plan, not all the safety strategies have developed performance measures and targets. This plan is typically short-range in nature. The Statewide Long Range Transportation Plan needs to add more specific long-term safety strategies like our highway safety strategic plan has done for the short range. More rigorous analytical methods could be added to the evaluation of the potential effectiveness of alternative strategies. Not all of the safety strategies are monitored for effectiveness and included in summary reports.

What are the barriers to implementing this framework?

WisDOT does not really have barriers to safety planning but does have challenges. The coordination of all the safety areas in the department is certainly a challenge. There are at least seven different areas that need to work together to produce effective plans. Also, the development of meaningful and achievable goals is a challenge. Simply reducing crashes is not a meaningful goal, yet it is difficult to arrive at an exact percentage as an achievable goal.

What lessons have you learned in addressing safety in your state transportation plan that may be useful to other states?

The statewide long-range plan needs to address safety policies and strategies. It also needs to be sure it includes meaningful safety goals, measurable performance measures, and effective strategies. The prioritization of highway projects needs to consider safety issues and address them in a comprehensive manner considering the 3 E's (engineering, education, and enforcement).

BINGHAMTON METROPOLITAN TRANSPORTATION STUDY (BMTS)

To what extent is the framework presented in the NCHRP 8-44 initial draft report relevant to what you are doing in addressing safety in your statewide or metropolitan transportation plan?

The framework is very relevant; in many ways it replicates the traditional metropolitan planning process. The following considerations are offered:

- Much safety-related planning implicit in the initial draft report is reactive, focused on fixing yesterday's high-crash locations. While this is important ongoing work, transportation plans need to be more forward looking. BMTS's sense is that few transportation planners, for example, look at demographic trends and, having noted an aging population (as here in Binghamton), include investments to address the unique needs of elderly drivers and pedestrians. While planners look at the transportation impacts of land use development in both the near- and

long-term, how often do they translate "this much residential growth will require a new school, and the location of that school will have specific consequences for safety." The list of examples could go on, but the point is that planning is in part about choosing the best investments, and part is about informing decision makers of the consequences of choices. The profession does not do a very good job of recognizing the transportation safety consequences of nontransportation choices.

- Regarding plan and program development, it is useful to distinguish between safety projects and safety elements of larger projects and not get caught up in accounting exercises to determine how well safety is recognized in a plan or TIP. For example, in BMTS's experience, a $10 million urban arterial street reconstruction may include countermeasures to address a high-crash location in the project limits may construct new sidewalks, signal system improvements, and bus stop pullouts. However, as project accounting goes, it will probably be counted as "system preservation." The framework's emphasis on system safety performance is the right way to address this, but it often is too easy to fall back on spending as the measure of effectiveness.
- Rigorous evaluation to level the playing field in establishing priorities for programming can be double-edged. For example, BMTS's pedestrian plan was very much grounded in safety improvements. A priority of the plan was to construct sidewalks along all bus routes on the basis that it is unsafe for people to have to walk in the street and wait at the curb to catch a bus. The history of pedestrian-involved crashes is, however, minimal; without a problem to correct, one might conclude that spending money on sidewalk construction is not a priority.
- There is a need to acknowledge scaling of the process to fit the region and resources. The framework is very robust but has to recognize the need to be integrated with all of the other elements that comprise an MPO regional transportation plan, from community visioning to air quality conformity to system preservation. Addressing all of the elements in the framework as a stand-alone safety plan would be resource intensive. Doing so in the context of a regional plan creates opportunities for integration but also demands resources: staff time, dollars, and the attention of decision makers. The final report might speak to how to integrate safety when an MPO approaches its plan from a modal perspective (a freight plan, a pedestrian plan, etc.), since that approach is not uncommon.

What are the gaps between what you are doing and what this framework suggests?

While planners engage stakeholders in the enforcement and education communities in the planning process, the planning profession has not previously considered explicitly incorporating those viewpoints in our regional transportation plan. The profession will need to investigate how an MPO can effectively include performance measures that are not directly related to infrastructure or operations improvements. Given the typical fund sources of these activities, they would not appear on the TIP. BMTS's sense is that it will take time to build credibility with agencies so they will agree to having their performance included in an overall evaluation of regional transportation safety even though they receive no funding through the MPO.

What are the barriers to implementing this framework?

A significant barrier is data collection and dissemination. In New York, crash record databases involve the Department of Motor Vehicles and the DOT, which maintains separate databases for state system and off-system networks. MPOs do not currently have access to directly query the

database but must do so through DOT. A new safety information system has been developed; the issue of providing access to users outside the DOT, including MPOs, has not been resolved by the DOT legal staff.

The ability of MPOs to directly collect safety-related data is minimal; we must rely primarily on operating and enforcement agencies to share data they collect. There is sometimes reluctance to do so since an agency may feel they will be made to look bad with their own data.

While there are evaluation tools that work at the program development level to identify and assign priority to safety projects and elements, this is a much more difficult exercise than the regional plan level. It is hard to understand (and to help decision makers understand) how to address transportation safety at the regional scope and in a long-range time frame.

What lessons have you learned in addressing safety in your metropolitan transportation plan that may be useful to other MPOs?

BMTS has been able to develop substantial credibility with our members through a Local Engineering Assistance Program, which provides traffic engineering expertise to municipalities that have none. Elected officials have learned the benefits of addressing safety problems from a professional perspective and have been more willing to hear about broader issues (safety and others) at the MPO planning table.

BMTS has also been able to accomplish some safety improvements through the mode-specific plans referenced above—particularly with respect to nonmotorized modes. Although BMTS would prefer a fully integrated approach, we sometimes take what we can get.

APPENDIX C

Ohio's Highway Safety Program

BACKGROUND

For more than 30 years, safety has been the Ohio Department of Transportation's (ODOT's) top priority. Each year, ODOT spends millions of dollars on improvements that make Ohio highways safer for motorists. Whether adding new signs and pavement markings to a busy Interstate highway or reconfiguring a high-crash intersection on a two-lane road, ODOT incorporates safety into every element of the process.

Over the decades, this attention to safety has reaped enormous benefits for Ohioans. Since 1940, the number of deaths has dropped from 12.5 to 1.3 deaths per 100 million vehicles miles of travel. This occurred despite a dramatic rise in motorists using these roads each year. Traffic volume statewide has grown by about 2% annually. Despite these improvements, the number of crashes over the past decade has remained constant at about 385,000 crashes per year.

In 2002, ODOT developed new strategies that may jump-start this stagnant trend. In July, the department merged its strategic initiatives for safety and congestion to create a new safety program that addresses high-crash rural locations, as well as growing congested freeway segments. The new program identifies areas where congestion and crashes often overlap, and prioritizes specific projects for immediate and long-term funding.

CRASH DATA

In the recent past, ODOT received crash data (OH-1 reports) a year to a year and a half after the incident occurred. Accident analysis and trends were never current because the lag time for obtaining crash reports was so great.

Currently, ODOT receives monthly crash data (OH-1 reports) updates. The monthly updates are typically 4 months dated (meaning the crash occurred four months prior to ODOT's receipt).

In the future, through an ODPS and ODOT partnership, ODOT and ODPS hope to get real time crash data (OH-1 reports) using GPS and personal digital assistants (PDAs).

THE CURRENT HIGHWAY SAFETY PROGRAM

Under the current combined safety and congestion program, ODOT is taking a fresh look at both its rural and urban high-crash locations as well as updating the reporting and analysis tools needed to make better safety-related decisions.

By layering congested locations on the rural and urban system with high-crash locations statewide, the department discovered staggering facts that have helped reshape the safety program. A recent analysis uncovered that 43% of all freeway crashes occur on 12% of the

freeway system. Similarly, 20% of all nonfreeway location crashes occur on just 2% of the nonfreeway system.

By focusing resources on these target-rich locations, ODOT may be able to reduce the number of crashes statewide by almost half.

Methodology

ODOT will continue to use the historical methodology that prioritizes high-crash locations by severity, frequency, and crash rate. This will ensure that the department continues to address problems on its rural highway system.

In addition, the department has expanded its safety program to address high-crash freeway locations in urban areas. To address these problems, ODOT has shifted the focus of the Highway Safety Program from crash rate to crash frequency and density. All of the freeway locations that exceed the predetermined crash frequency threshold are listed on a district Safety and Congestion Work Plan as crash "hot spots" that ODOT must address.

Schedule

- The complete year of crash data is made available by ODPS in the middle of April.
- Crash data are cleaned and validated (made loggable) by the Office of Systems Analysis Planning. Systems Analysis Planning completes the cleansing and validation of the data around the middle or end of May.
- In early June, the Office of Safety/Congestion analyzes the data and produces the high-crash location listings, the safety and congestion "hot spots," and the GIS mapping pertaining to the locations.
- The Office of Technical Services analyzes the Congestion Management Model annually in April. This list is typically ready for publication in May or June.

Publications

- The High-Crash Location Identification System (HCLIS) listing is produced by the HSP software on the mainframe (Roscoe). The list is distributed as a PDF file and as a hard copy in a binder to the districts and divisions, and it is included on the Safety and Congestion Work Plan.
- The safety "hot spots" listing is produced by the RT200 software on the mainframe (Roscoe). The list is manually transferred to a Quattro Pro file and distributed electronically and via hard copy as the Safety and Congestion Work Plan.
- The congestion list is produced by the Office of Technical Services and manually transferred to a Quattro Pro file and distributed electronically and via hard copy as the Safety and Congestion Work Plan.
- Every month, the Office of Safety/Congestion manually produces a Low-Cost and Short-Term Tracker to track all low-cost safety and congestion projects for FY 2004.

Requirements

ODOT districts are required to study 200 nonfreeway locations and 50 freeway locations on the HCLIS and all of the safety and congestion "hot spot" locations on the district Safety and Congestion Work Plan. All studies must be finished within 1 year of the published high-crash listing and Safety and Congestion Work Plan. Each study must produce a range of solutions including the following:

- Low-Cost/Short-Term—projects under $100,000 and constructed within 1 year (e.g., optimizing signal timing, updating signing and striping, and signal coordination, etc.).
- Medium Cost/Midterm—projects ranging from $100,000 to $5 million and constructed within 1 to 5 years (e.g., reconfiguring interchange ramps, adding two-way, left-turn lanes, and adding capacity on nonfreeway facilities).

Evaluation

The Office of Safety/Congestion will manually evaluate all low-cost–short-term countermeasures on the tracker. The intent is to find statewide best-practice countermeasures for mitigating crashes and congestion.

The Office of Safety/Congestion will manually evaluate all countermeasures on the Safety and Congestion Work Plan. The intent is to find statewide best-practice countermeasures for mitigating crashes and congestion and research the benefit-to-cost ratio for all countermeasures.

The Future Highway Safety Program

The plans are to

- Streamline the cleaning and validation of the current crash data;
- Improve the loggability of the current crash data;
- Develop a process to log future GPS crash data to the Ohio roadway system in a timely manner;
- Totally rewrite the HSP Safety Program, developing a Windows-based user interface and a much more user-friendly program; and
- Automate the population of the Safety and Congestion Work Plan with all fields currently on the work plan.

APPENDIX D

Participants

Peer exchange participants represented 13 different states, one metropolitan planning organization, the Federal Highway Administration, TRB, and several universities and private consulting firms. Most participants were members of the TRB Committee on Statewide Multimodal Transportation Planning. Table 1 lists the names of participants and their affiliated agencies or organizations.

PARTICIPANTS AT 2004 STATEWIDE PLANNING PEER EXCHANGE

Charlie Howard, *Washington State DOT*, *Chair*
Bruce Bender, *Vermont Agency of Transportation*
Brian Wall, *Pennsylvania DOT*
Suzann Rhodes, *Ohio DOT*
John Quick, *Utah DOT*
Susan Mortel, *Michigan DOT*
Mary Lynn Tischer, *Virginia - Office of the Governor*
Abby McKenzie, *Minnesota DOT*
Sandy Straehl, *Montana DOT*
Ysela Llort, *Florida DOT*
Ken Leonard, *Wisconsin DOT*
Bob Romig, *Florida DOT*
Kyle Kittrell, *Missouri DOT*
Brian Smith, *California DOT*
Toby Rickman, *Wisconsin DOT*
Steven Gayle, *Binghamton Metropolitan Transportation Study*
Ron McCready, *National Cooperative Highway Research Program*
Kim Fisher, *Transportation Research Board*
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