# MPO Guidebook for Using Safety as a Project Prioritization Factor

September 2016


U.S. Department of Transportation
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## NOTICE



## QUALITY ASSURANCE STATEMENT



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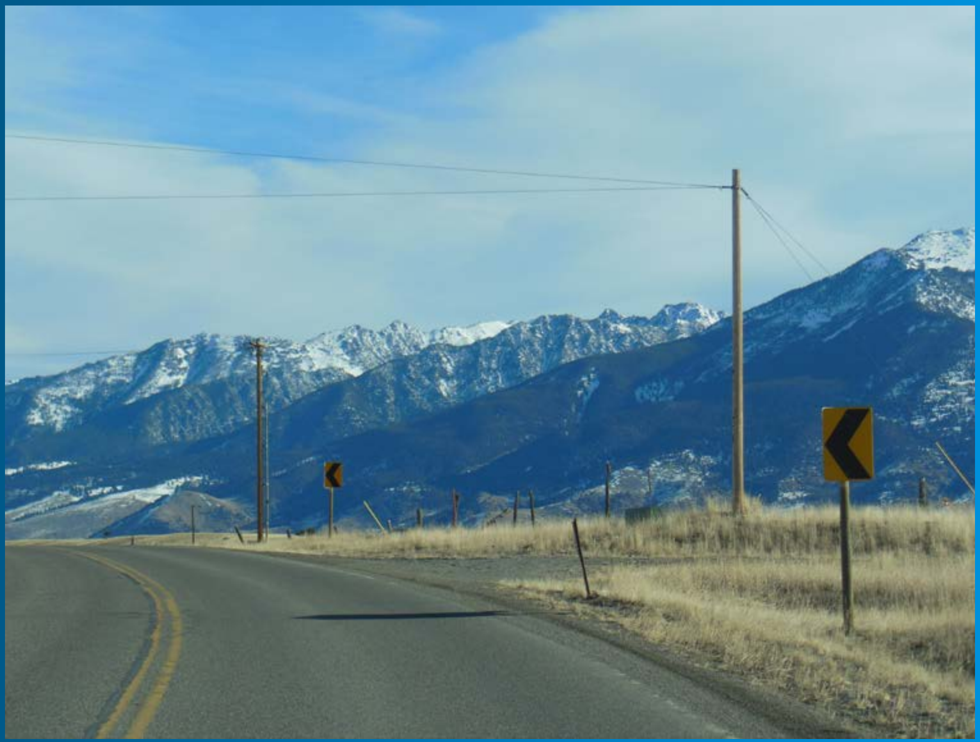
# 1.0 Introduction

Every transportation investment is an opportunity to incrementally improve the safety of the transportation system. Transportation investments must be evaluated to ensure they do not degrade safety, given that each transportation project has many competing purposes. The purpose of this project is to identify the state of the practice by Metropolitan Planning Organizations (MPO) using safety as a project prioritization criterion and to identify potential methods for using safety as a factor in project prioritization. The project included a literature review, interviews with MPOs, and definitions of recommended approaches. The research team reviewed Metropolitan Transportation Plans (MTP) and Transportation Improvement Programs (TIP) for 52 MPOs identified as potentially employing good practices in project prioritization and consideration of safety. The research team conducted interviews with nine MPOs identified as having a well-defined project prioritization process that explicitly considers safety. The nine agencies interviewed were:

- Baltimore Metropolitan Council, Maryland (BMC).
- Champaign-Urbana Urbanized Area Transportation Study, Illinois (CUUATS).
- Charlotte Regional Transportation Organization, North Carolina (CRPTO).
- Fredericksburg Area Metropolitan Planning Organization, Virginia (FAMPO).
- Lexington Area Metropolitan Planning Organization, Kentucky (LAMPO).
- Pikes Peak Area Council of Governments, Colorado (PPACG).
- Puget Sound Regional Council, Washington (PSRC).
- San Diego Association of Governments, California (SANDAG).
- Southeastern Regional Planning and Economic Development District, Massachusetts (SRPEDD).

The interviews focused on the project prioritization processes MPOs use and methodologies for incorporating safety considerations into prioritization criteria. This Guidebook details a range of options for considering safety in project prioritization processes based on the practices identified. The approaches in this Guidebook also include methods beyond those that currently are in practice that incorporate enhancements to current process and use of new tools. The methods are categorized into three levels of complexity so MPOs of all sizes and at all stages of performance-based transportation planning can identify appropriate methods to effectively incorporate safety into project prioritization.



(Source: Cambridge Systematics, Inc.)

# 2.0 Legislative Context

The Statewide and Nonmetropolitan Transportation Planning; Metropolitan Transportation Planning Final rule § 450.306 (b) published May 27, 2016, describes 10 required planning factors, one of which is safety. The rule states:

> *The metropolitan transportation planning process shall be continuous, cooperative, and comprehensive, and provide for consideration and implementation of projects, strategies, and services that will address the following factors:*

- *Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency;*
- ***Increase the safety of the transportation system for motorized and nonmotorized users;***
- *Increase the security of the transportation system for motorized and nonmotorized users;*
- *Increase accessibility and mobility of people and freight;*
- *Protect and enhance the environment, promote energy conservation, improve the quality of life, and promote consistency between transportation improvements and State and local planned growth and economic development patterns;*
- *Enhance the integration and connectivity of the transportation system, across and between modes, for people and freight;*
- *Promote efficient system management and operation;*
- *Emphasize the preservation of the existing transportation system;*
- *Improve the resiliency and reliability of the transportation system and reduce or mitigate stormwater impacts of surface transportation; and*
- *Enhance travel and tourism.*

Projects should *increase* the safety of the transportation system. It is not enough to simply “consider” safety in the planning process. And most certainly they should not degrade safety, even if they have a primary purpose other than safety. In addition, the planning rule describes the new requirements for MPOs to set performance targets for tracking progress toward attainment of critical outcomes for the MPO region, one of which is safety. MPOs are required to either set five annual safety targets for their planning areas or adopt the State safety targets, as noted in the Safety Performance Management Rule (23 CFR Part 490). They will then be required to track progress toward achieving these targets in the System Performance Plan, which is required as part of their MTP.

While the set of projects selected by an MPO will need to achieve multiple, and sometimes competing, objectives, it is clear that to ensure progress toward reducing fatalities and serious injuries in MPO regions, safety will need to be explicitly considered in project selection. While many MPOs do consider safety in their current project prioritization processes, many do not. Moving forward, MPOs will need to review and likely enhance how they include safety in the project prioritization process.

## Performance-Based Transportation Planning

The new Federal requirements for evidence-based target setting will lead agencies to adopt and enhance performance-based transportation planning processes. Performance-based planning and programming (PBPP) refers to the application of performance management within the planning and programming processes of transportation agencies to achieve desired performance outcomes for the multimodal transportation system. This includes a range of activities and products undertaken by a transportation agency together with other agencies, stakeholders, and the public as part of a 3C (cooperative, continuing, and comprehensive) process. It includes development of: MTP, other plans and processes, including those Federally required, such as Strategic Highway Safety Plans (SHSP), Transportation Asset Management Plans (TAMP), the Congestion Management Process (CMP), Transit Agency Asset Management Plans, and Transit Agency Safety Plans, as well as others that are not required, and programming documents, including State and metropolitan Transportation Improvement Programs (STIP and TIP). PBPP attempts to ensure that transportation investment decisions are made—both in long-term planning and short-term programming of projects—based on their ability to meet established goals. Using a performance-based approach, as shown in figure 1, MPOs establish a framework to more effectively select programs and projects that align with safety goals and will help the region reach performance targets. If a region wants improved safety outcomes, safety must be appropriately included at all phases of the performance-based planning process.

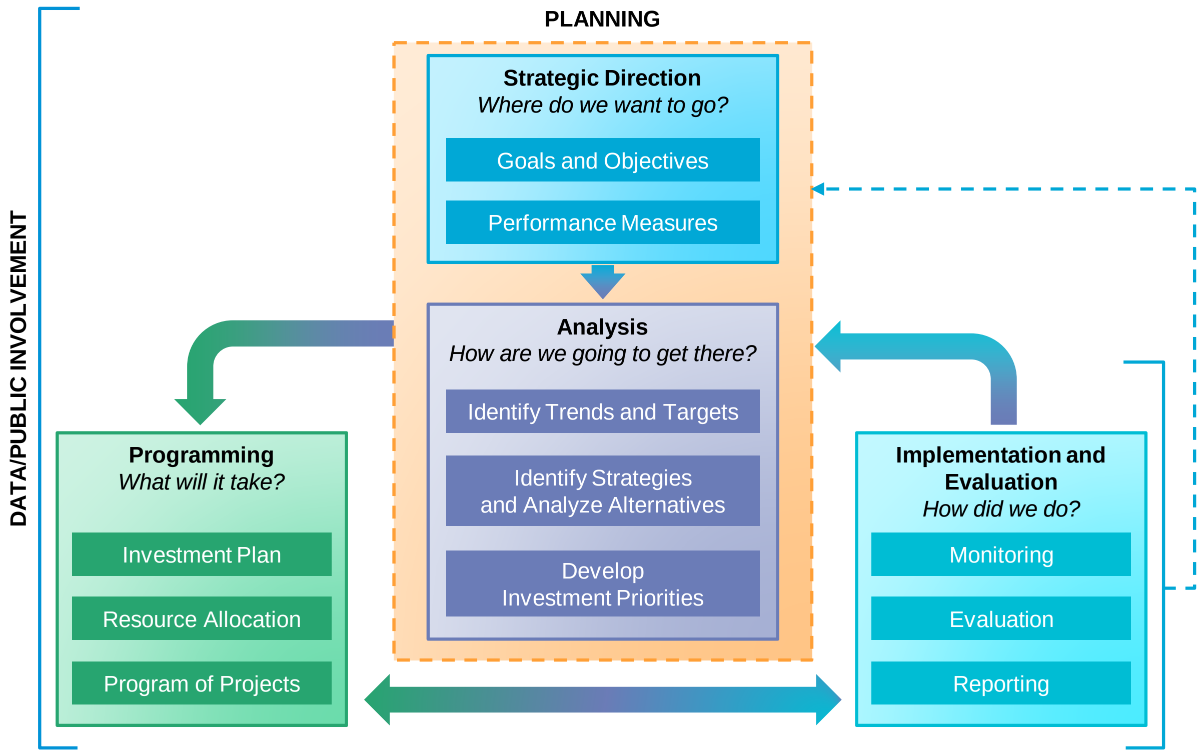



Figure 1. Flow chart. Performance-based planning and programming process.

(Source: Performance Based Planning and Programming Guidebook, September 2013.)

## Challenges

As shown, performance measures should be aligned with an agency's goals and objectives. Most MPOs include safety as a goal. Many MPOs, however, still do not explicitly consider safety in project prioritization, despite safety being a required stand-alone planning factor. Research from the National Cooperative Highway Research Program (NCHRP) 811, Institutionalizing Safety in Transportation Planning Processes: Techniques, Tactics and Strategies, identified a number of advances MPOs have made when it comes to incorporating safety into the planning process, but identified a gap when it comes to evaluating, prioritizing, and ultimately programming projects.

A primary challenge is the belief that safety will be handled later, during the project design phase. However, design standards are not always optimized to minimize crash frequency or severity. The primary purpose of design references, such as the American Association of State Highway and Transportation Officials (AASHTO) Green Book, is to develop guidance for design so roadways are consistent and users know what to expect. It is important that safety strategies match solutions to crash patterns or locations determined to have elevated risk, which enables reduction in conflicts across modes and development of roadways with speeds appropriate to the context.

Another challenge is the absence of a tool to predict the safety benefits of future transportation projects. Many common evaluation criteria for other aspects of transportation can be generated by travel demand model results, such as air quality impacts, congestion impacts, and mode shift; and are easier for agencies to calculate than safety impacts. Changes in vehicle miles traveled (VMT) can be related to increased exposure to risk and can be an indication of mode shift to other safer modes. However changes in VMT alone are not a measure of the safety performance of roadway facilities. New tools have become available, such as the AASHTO Highway Safety Manual (HSM) and the FHWA Crash Modification Factors Clearinghouse (CMF Clearinghouse), which present methods of forecasting crash, fatality, or injury benefits anticipated from a specific type of improvement, and this Guidebook presents ways to use them in project prioritization processes.

## Table 1. Federal funding categories.

(Source: U.S. DOT.)

| Federal Funding Category | Lead Responsible Agency | FY 2016 Funding (millions) |
|---|---|---|
| National Highway Freight Program | | $1,140 |
| Highway Program | | |
| National Highway Performance Program | State DOT | $22,332 |
| Surface Transportation Block Grant Program | MPOs in urbanized areas >200,000 population, State DOT in all other areas | $11,163 (includes estimated $2,930 to TMAs) |
| Congestion Mitigation and Air Quality Improvement Program | State DOT | $2,309 |
| Highway Safety Improvement Program | State DOT | $2,226 |
| Transit Programs | | |
| 5307 Urbanized Area Formula Grants | State in urbanized areas <200,000 population. State or designated recipient in urbanized areas >200,000 | $4,508 |
| 5310 Enhanced Mobility for Seniors and Persons with Disabilities | State in urbanized areas <200,000 population and rural areas. State or designated recipient in urbanized areas >200,000 | $265 |
| 5311 Grants for Rural Areas | State | $697 |
| 5337 State of Good Repair Program | State in urbanized areas <200,000 population. State or designated recipient in urbanized areas >200,000 | $2,507 |
| 5339 Bus and Bus Facilities | State in urbanized areas <200,000 population. State or designated recipient in urbanized areas >200,000 | $696 |

Given the increasingly constrained transportation funding available and the steadily increasing cost to maintain the transportation system, many MPOs are finding that the majority of regional transportation funds are allocated to system preservation. In a handful of regions system preservation needs are so high that there are very few Federal discretionary funds available for project selection to take place. As funding shifts away from system expansion projects and towards maintenance of the existing system, the focus of project selection shifts to criteria to assess pavement or bridge conditions. However, it is possible to use safety as a criterion when deciding upon a particular maintenance project as maintenance projects offer an opportunity to integrate low-cost safety improvements.

## MPO Project Selection Authority

When considering project prioritization processes, it is important to consider the types of projects over which MPOs have authority for investment decisions. States are provided the authority to program the majority of Title 23 funds. MPOs serving areas with populations over 200,000, or Transportation Management Areas (TMA), have selection authority for suballocated Surface Transportation Block Grant (STBG)-funded projects, in consultation with the State and any affected public transportation operator. Similarly, STBG set-aside funds for Transportation Alternatives projects suballocated to TMA MPO areas are programmed for eligible projects identified by the MPO through a competitive selection process.

In non-TMA MPO areas, States have selection authority for all STBG-funded projects, in consultation with the MPO. STBG set-aside funds suballocated to small urban areas served by a non-TMA MPO are required to be administered by the State, and the State is responsible for selecting these projects identified through a competitive process. The State should consult with MPOs to ensure that MPO priorities are considered.

For the majority of transit projects funded under Title 49, the designated recipients of public transportation funds have project selection authority, in cooperation with the MPO if the MPO is not the designated recipient. The State is the designated recipient for some transit programs; an MPO or transit agency is typically the designated recipient for others.

Table 1 presents these funding categories, national funding apportionments for fiscal year (FY) 2016, and project selection authority identified by Federal law. As shown in the table, the vast majority of Federal transportation funds are programmed by agencies other than MPOs. Although MPOs are required to account for all transportation funds available to their regions in their MTPs and TIPs, they do not have control over how most of the funds are spent.

MPOs are sometimes provided additional project selection authority for some funds, above and beyond that provided by Federal statute. This is often due to State-level policies or legislation, or agreements with local transit providers. For instance, while Federal guidance calls for projects supported with Congestion Mitigation and Air Quality Program (CMAQ) funds to be selected by the State or the State in conjunction with an MPO, many states suballocate their share of CMAQ funds to MPOs in nonattainment or maintenance areas and allow them to take the lead in selecting and programming CMAQ-eligible projects. (U.S. Department of Transportation (2013). The Congestion Mitigation and Air Quality (CMAQ) Improvement Program Under the Moving Ahead for Progress in the 21st Century Act, Interim Program Guidance.)

Likewise with Highway Safety Improvement Program (HSIP) funds, the State manages the disbursement of funds directly to local jurisdictions. Generally, the MPO has little or no role in project identification or prioritization of HSIP funding although these projects are included in the region's TIP. However, in a few instances, a State will allocate HSIP funds to MPOs to program for safety-specific projects in the MPO region. For example, Pennsylvania receives approximately $98 million per year in Federal HSIP funding under the FAST Act. Of that funding, $35 million is reserved for various statewide safety initiatives and $12 million is divided evenly among the urban and rural regions to provide each MPO and RPO a $500,000 base amount of funding. The remaining funds are allocated to the planning regions based on a formula using 50 percent fatalities and major injuries, and 50 percent reportable crashes. (May 23, 2016 FHWA Safety Target Setting Coordination Workshop.)

## The Project Prioritization Process

Project prioritization is defined as the method by which transportation agencies rank projects in order of importance. Effective project prioritization defines the transportation needs for a State or region and strengthens agencies' ability to strategically plan. Prioritization helps agencies maximize limited transportation funding and also provides an opportunity for communication and coordination between State, regional, and local planning agencies. (U.S. Department of Transportation (2015). Cross Modal Project Prioritization: A TPCB Peer exchange, [http://www.planning.dot.gov/Peer/NorthCarolina/NCDOT_cross-modal_12-16-14.pdf](http://www.planning.dot.gov/Peer/NorthCarolina/NCDOT_cross-modal_12-16-14.pdf) – Accessed July 2015.) Prioritization for an MPO generally involves the following steps:

- Identifying transportation needs and goals.
- Seeking public input.
- Developing criteria and evaluation measures.
- Conducting evaluation.
- Ranking projects using criteria.
- Creating finalized project lists for the MTP, TIP, or STIP.

Transportation project prioritization is not a straightforward matter in practice, and no single technique or metric, including benefit-cost analysis, is or should be relied on exclusively by multimodal agencies to compare projects across modes. Indeed, if any single theme emerges consistently, it is that no single approach is "best," as agency goals and operating conditions vary. Agencies pursue prioritization processes that are flexible and appropriate to their goals and conditions, and that reflect multiple criteria. Individual transportation projects are ranked in order of importance during prioritization so that the amount of available funding is allocated to projects that are most important. In a typical MPO prioritization process, desired transportation projects are identified by stakeholders in the planning area. These projects are evaluated using criteria to determine how well they meet transportation goals and objectives established for the region. This evaluation process results in a score for each project. The projects are then ordered by score. These

**Project Prioritization** is a process of applying criteria that support agency goals to a set of proposed projects and determining which projects will result in the greatest progress toward achieving targets.

**Transportation Programming** is the commitment of transportation funds to be available over a period of several years to particular projects, as occurs in the Transportation Improvement Program (TIP).

results are used in project programming, which is the process of matching transportation projects with available funds, to identify the projects that will receive funding in the MTP and TIP.

The MTP and the TIP are subject to the fiscal constraint requirement in the FAST Act. These requirements are intended to ensure that MTPs and TIPs include sufficient financial information for demonstrating that projects can be implemented using committed, available, or reasonably available revenue sources, with reasonable assurance that the Federally supported transportation system is being adequately operated and maintained, rather than being lists that include many more projects than could realistically be completed with available revenues.

The MTP identifies the prioritized projects to be funded over the 20-year (minimum) time horizon of the Plan. The TIP identifies the priority projects to be funded in the next 4 years. Although the MTP and the TIP must be fiscally constrained, some agencies also include an illustrative or unconstrained project list in these documents, which identifies additional projects that would be included on the fiscally constrained list if additional funds were available. Incorporating safety considerations into the transportation project prioritization process has the potential to transform the transportation system over time into one that is progressively safer, reducing the loss of life and number of serious injuries.

As noted in MPO interviews, the primary motivation for developing and using a project prioritization process is to add objectivity to project selection. Instituting a project prioritization process is typically a long and arduous task, involving significant reflection on an agency's goals and objectives and how to quantify project benefits via prioritization criteria. However, agencies generally feel the benefits are worth the effort and generally report widespread acceptance of the processes from decision-makers and the public. Having a well-defined and clear prioritization process increases public confidence in the planning process and increases buy-in from member jurisdictions. A well-defined prioritization process more directly supports transportation goals and objectives established in a region and directs limited funding towards achieving those goals.

Before defining methods for prioritizing projects inclusive of safety, it is important to recognize that multiple methods are used by MPOs to select projects. During the literature review the study team identified several types of approaches, which may be combined in their ultimate application. Approaches include:

- Cross modal—In the cross modal typology, prioritization is performed across transportation modes and funding sources, using a single set of criteria that address a region's goals and objectives. This is often thought of as the ideal approach to identifying the mix of projects that would provide the most benefit to a region's transportation network given the amount of available funding. The Metropolitan Transportation Commission (MTC), the MPO for the San Francisco bay area in California, scores each major project under consideration according to how it would impact 10 different target areas identified by stakeholders, such as equitable access, preserving the system, etc. MTC carefully selected performance targets for each goal area to avoid those that may be biased toward a particular mode.
- Mode specific—Under this approach, prioritization is done by mode (i.e., highway, bicycle, and pedestrian, transit, etc.). Prioritization criteria or weighting may vary by mode. Separate project lists are typically developed for each mode, and projects of different modes are not compared against each other. This approach is the most common among the MPOs researched for this effort.
- Funding source based—With this approach projects are prioritized by Federal funding source (e.g., STBG, CMAQ, National Highway Performance Program, etc.). For example, to program its TIP, the Mid-America Regional Council in Kansas City issues a call for projects eligible for CMAQ funding, a separate call for projects eligible for STP/STBG funding and a separate call for projects eligible for STBG Set-Aside funding. Applications submitted for each call are evaluated by separate committees using different scoring criteria.
- Goals and objectives based—Projects may be prioritized based on how well they relate back to goals and objectives established in the LRTP. For example, the Lexington, Kentucky Area 2040 MPO Metropolitan Transportation Plan defines eight transportation goals and numerous objectives for the region. The MPO developed a project scoring process using criteria based on each of the eight goals and associated objectives. Within the safety goal, a project can achieve a maximum of 8 points out of a total of 100 for all criteria, based on: crash history along the facility, whether the project addresses a

bike or pedestrian safety issue, and whether the project specifically includes safety improvement strategies for highway, bike/pedestrian, and traffic calming/signage/signal upgrades.

- Program based—Under this approach prioritization is conducted by program type, e.g., safety, congestion relief, system preservation, equity, etc. For example, the Puget Sound Regional Council in Seattle, Washington developed a prioritization framework for its Transportation 2040 LRTP, which divides projects into four program categories. The MPO then uses nine project evaluation measures to evaluate how well projects would implement the region's vision. The nine measures are: air quality, freight, jobs, multimodal, land and water, safety and system security, social equity and access to opportunity, support for centers, and travel. Scores for each of the nine measures are calculated and used for prioritization.
- Scenario based—Some MPOs develop multiple transportation scenarios and then choose the scenario with the package of projects that provides the greatest overall benefits or best meets the region's transportation goals and objectives. For example, the Wichita Area MPO (WAMPO) project selection process for the 2035 MTP used several measures of effectiveness (MOE) to select the preferred scenario, of which safety is one. WAMPO issued a call for projects to transit providers, cities, counties, and the State. A Project Advisory Committee (PAC) developed seven MOEs to evaluate how well the submitted projects would advance or achieve the goals and objectives for the region. The PAC applied scores to each of the projects based on the MOEs. For safety, the MOE is whether the project addresses or helps address a safety concern. WAMPO's travel demand model was used to show the impacts of the proposed projects on the future transportation system. The impacts were primarily measured by an increase or decrease in congestion, vehicle miles traveled, and vehicle hours traveled. After scoring all projects, the PAC developed an initial list of projects based on scores and available funding that comprised the initial scenario.

At present, most DOTs and MPOs use "programmatic category"-based approaches to prioritize projects for funding, whereby projects are categorized and put into silos based on mode (e.g., highway, rail, port, aviation, ferry, bridge, bicycle and pedestrian, transit) and/or program (e.g., safety, preservation, capacity, etc.). (Gunasekera, K. and Hirschman, I. (2014). NCHRP 08-36, Task 112, Cross

Mode Project Prioritization, American Association of State Highway and Transportation Officials, Standing Committee on Planning, http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP08-36(112)_FR.pdf – Accessed July 2015.) Each category has its own prioritization process based on criteria unique to the specific mode or program. These criteria are generally not applied across modes because metrics are often mode specific.

Agencies may include safety as a criterion for all modes or only some modes, or in all funding categories or only some. However, ideally safety is considered for all projects.

## Weighting of Prioritization Criteria

Once criteria are identified they may be weighted, which establishes importance of safety relative to other priorities. Typically, the process of defining criteria for prioritizing projects is accomplished through one or more MPO committees. The committee members are usually representatives of local, regional, and State agencies. Input from the public obtained during public participation events is often factored in when defining the criteria and the weights to be assigned. At some MPOs, such as the Hampton Roads Transportation Planning Organization in Virginia, software is used to help process inputs and calculate weights based on stakeholder or public input. As a result the criteria and how they are weighted often incorporates a political element. The criteria and weighting should reflect the plan goals and community values. Weighting may differ if prioritization is approached differently by mode, program, or funding category.

## When to Address Safety in Project Prioritization

Another consideration is when to address safety in the planning process. Agencies may address safety in their MTP or TIP, or via corridor or other special studies.

For the MTP, projects of regional significance are evaluated formally. At this point in the planning process projects may be more conceptual with fewer design details than for projects at the programming stage. This can present challenges in terms of having enough detail to know how to evaluate safety. However, if agencies decide to use a specific methodology they can request more detailed information from project sponsors to enable improved safety evaluation.

At the TIP stage, more project details are typically available. At this stage it should be easier to know if safety countermeasures are incorporated into project design.

For corridor studies, detailed analysis of safety conditions/data in the corridor should be included in the study scope. Ideally the corridor study would include evaluation of crash conditions along the corridor, possibly a road safety audit to evaluate existing conditions at key locations and possibly use of the HSM-predictive method or CMFs to evaluate safety conditions under different alternatives under consideration.

For other types of special purpose plans such as pedestrian or bicycle plans, project design elements may also be more readily available. As more specific project information is available more specific safety evaluations can be considered (e.g., CMFs or the HSM-predictive method). Over time as the MPO gets used to the data it will need to prioritize projects using a safety criterion, it can work with project sponsors to obtain the needed project information.

## Guidebook on Safety Data for Transportation Planners


(Source: Federal Highway Administration.)

This guidebook provides State and regional planners with information on how to effectively use safety data and analysis tools in performance-based transportation planning and programming processes.

# 3.0 Approaches for Incorporating Safety as a Prioritization Criterion

In this section approaches are detailed for incorporating safety as a prioritization criterion. Within each method, a basic, intermediate, and advanced approach is described. The basic level provides an adequate level of consideration for safety in project prioritization, which may be appropriate for Metropolitan Planning Organizations (MPO) that are developing safety criteria for the first time or have very limited resources. As agencies become more experienced at working with safety data and safety analysis and countermeasures, they may progress to the intermediate or advanced level, or develop a safety criterion that incorporates multiple approaches.

MPOs may use safety as a criterion for project selection in the Metropolitan Transportation Plan (MTP), Transportation Improvement Program (TIP), corridor, or special purpose studies, or all of the above. They may find that certain methods are more appropriate at earlier phases of planning when less project detail may be available and others more appropriate for the TIP process, when more detail is likely available. Agencies can choose the type or complexity of approach based on data availability, stage in the planning process, internal skills and capacity, or appropriateness for project types being evaluated.

The following sections describe these six approaches for prioritizing projects using safety as a criterion:

1. Network Screening.
2. Systemic.
3. Countermeasure-Driven.
4. Complete Streets.
5. Mode Shift.
6. Benefit-Cost Analysis.

MPOs will need to determine which approach or combination of approaches is appropriate for their project prioritization process. The approach selected will likely depend on the overall methods used for project prioritization (i.e., cross modal, mode-specific, program-based, etc.), number of projects undergoing detailed scoring and review, and level of expertise and resources for analysis. For example, an MPO could allocate a total of 20 points for safety using two methods and award up to 10 points for each method. For agencies that do not use a cross modal method and that review groups of projects in different categories, they may choose to use different methods for different project categories or program types.

For each method, the Guidebook provides:

- Sample criterion—description of how a criterion might be worded. This gives a sense of how the method would be used for actual project prioritization, which an MPO can refine.
- Analysis method for problem identification—description of analysis required to define safety problems at a project location or on a defined system.
- Analysis method for project development—description of analytical and project development approach to ensure appropriate safety elements are included in the project to address identified safety problems.
- Data needed—list of data elements necessary for the analysis type.
- Level of complexity/technical expertise—description of difficulty and technical staff skills needed and level of effort for the approach. However some complex approaches may be made quite simple if the Department of Transportation (DOT) has conducted the analysis at a statewide level and can provide key information that the MPO does not need to calculate.
- Resources needed—description of staff and technical resources needed.
- Pros—description of advantages of the method.
- Cons—description of the limitations of the method.

- Considerations—other context or factors to take into account when considering or applying this method.
- List of Technical resources—list of guidebooks, reports, databases, and tools that will support performing this type of analysis.

## 1. Network Screening Approach

Network screening is the process of studying a transportation system for unusual safety performance. A particular portion or the entire network is evaluated using one or more methods to identify facilities that have better and worse safety performance than comparable facilities. Locations identified as having safety performance lower than expected are recorded as sites with potential for safety improvement; subsequent diagnosis and improvement will be needed. In the prioritization process, this method awards points to projects on a list of locations with potential for safety improvements based on review of crash history, and which also include elements to address the safety problems identified. Systemic analysis is a type of network screening but is addressed separately in the next section to highlight specific characteristics of that approach.

### Crash Modification Factors and Use in Planning

A Crash Modification Factor (CMF) is a multiplicative factor used to compute the expected number of crashes after implementing a given countermeasure at a specific site. For example, an intersection is experiencing 100 angle crashes and 500 rear-end crashes per year. If you apply a countermeasure that has a CMF of 0.80 for angle crashes then you can expect to see 80 angle crashes per year after implementing the countermeasure (100 x 0.80=80). If the same countermeasure also has a CMF of 1.10 for rear-end crashes, then you would also expect to see 550 rear-end crashes per year following the countermeasure (500 x 1.10=550). It is important to note that a CMF represents the long-term expected reduction in crashes, and this estimate is based on the crash experience at a limited number of study sites; the actual reduction may vary (CMF Clearinghouse).

CMFs are important for project prioritization because they enable a planner to quantify the safety impact of a proposed project. A planner can use CMFs to calculate whether a project will achieve a net safety benefit in terms of a reduction in the number and severity of crashes. If a project includes proven effective countermeasures (for which CMFs that show a safety benefit have been developed) it will usually have an overall improved safety profile. While often project sponsors believe a project will improve safety, tools such as CMFs can help ensure the project really will result in a reduction in fatalities or injuries. Effective use of safety criteria in the performance-based planning process will help ensure that the projects in transportation plans and programs will contribute to a reduction in fatalities and injuries in the region and achievement of safety targets.

## Table 2. Network screening.

*Sample criterion and methods.*

| | Basic | Intermediate | Advanced |
|---|---|---|---|
| Sample Criterion | Is the project at a location on a list of sites with potential for safety improvements based on crash history? If yes, does the project address the identified safety concern (yes = points, no = 0 points)? Zero points are awarded to projects at sites with potential for safety improvement that do not address the safety concern. | Is the project at a location on a list of sites (*using multiple screening methods*) with potential for safety improvements based on crash history (yes or no)? If yes, does the project address the identified safety concern (yes = points, no = 0 points)? Zero points are awarded to projects at a site with potential for improvement that do not address the safety concern. | Project is expected to reduce fatalities and serious injuries by ____. Scale to fatality/ serious injury numbers in the region such as: 10 or more = most points; 5-9 = moderate points; 1-5 = lower points; no impact = 0 points; fatalities and serious injuries are expected to increase = negative points. |
| Analysis Method *Problem Identification* | Use regional crash map to identify locations by number and/or severity of crashes. | Use two or more network screening methods that include traffic volume (e.g., critical crash rate, crash rate). Conduct analysis of fatal and serious injury crash rates by segment and by intersection, and by functional classification for major or all roadways in the region. It is preferable to focus only on fatal and injury crashes and avoid doing a simple crash rate analysis (using all crashes). | Use Highway Safety Manual predictive method. Screen network using safety performance functions for different functional classifications. This will identify locations where crashes exceed the expected number of crashes based on the characteristics of the roadway and the safety performance function associated with that roadway type. |
| Analysis Method *Project Development* | Determine how proposed projects will address the crash problem, e.g., if there are a large number of left-turn intersection crashes, does the intersection improvement address this such as by adding a left turn signal phase or a dedicated left turn lane? | Determine how proposed projects will address the crash problem, e.g., if significant numbers of roadway departure crashes are occurring at a curve, does the project include high-friction pavement, advanced warning signs, speed reduction signs, or chevron signs in the curve? Use crash modification factors to evaluate and quantify the anticipated impact of a project's treatments/policies on the safety performance at a location and to identify additional safety enhancements. | Potentially group locations (segments and intersections) identified with a safety need into tiers of severity. Provide highest safety points for projects at locations with highest level of need. Ensure projects are addressing the locations with safety problems. Use HSM predictive methods to evaluate and quantify the anticipated impact of a project's treatments/policies on the safety performance at a location/on a corridor. |

The Charlotte Regional Transportation Planning Organization's safety criteria for tier 1 evaluation is shown in figure 2 as an example of Analysis Method—Problem Identification. Formulas using network screening information are used to determine the extent of the safety problem where a project is proposed.

Tier 1 Criteria

- Congestion 100 points
- Safety 50 points
- Accessibility to Employment 50 points

Total 200 points

For the CRTPO LRTP, roadway projects must proceed through a two tier screening process. In tier 1, 25 percent of the score is safety. Safety is calculated based on:

- Roadway Safety Criterion: (Crash Density*33%) + (Crash severity*33%) + Critical Crash Rate*33%).
- Intersection Safety Criterion; (Crash Frequency*50% + Severity Index*50%).

Those projects proceeding into tier 2 screening are evaluated for: environmental justice, natural resource impact, historic resource impact, community resource impact, system connectivity, and benefit-cost ratio (not considering safety).

Figure 2. Chart. Flow chart. Charlotte Regional Transportation Planning Organization Long-Range Transportation Plan project evaluation process.

(Source: Charlotte Regional Transportation Planning Organization Metropolitan Transportation Plan 2040, Appendix C, Roadway Ranking Methodology.)

## Table 3. Network screening.

*Characteristics of approach.*

| | Basic | Intermediate | Advanced |
|---|---|---|---|
| Data Requirements | Crash and roadway data in geospatial format; countermeasure data. | Crash and roadway data in geospatial format, roadway characteristics (e.g., number of lanes, functional class, sidewalks, bike lanes, lighting, medians), traffic volume for network to be analyzed; countermeasure data. | Same as "Intermediate." |
| Complexity | Low-Moderate. Requires basic understanding of data management in spatial/GIS context. To award points for a project addressing a safety problem requires some understanding of how to apply safety countermeasures to address defined safety problems. | Moderate. Requires understanding of basic traffic safety analysis techniques such as calculating crash rate at intersections or along segments and ability to manipulate data. To award points for a project addressing a safety problem requires some understanding of how to apply safety countermeasures to address defined safety problems. | High. Requires advanced understanding of traffic safety theory and data manipulation, including statistical techniques. To award points for a project addressing a safety problem requires understanding of how to apply safety countermeasures to address defined safety problems. Ideally, involves use of Highway Safety Manual predictive method to test design alternatives of proposed projects and evaluate safety impacts. |
| Resources Needed | MPOs with staff capable of conducting GIS analysis can complete this task with a moderate level of effort. MPOs may obtain high crash location listing from DOT but may need a longer list of statewide high crash locations to identify several in the MPO area. | Requires MPO staff to develop familiarity with strengths and weaknesses of various network screening methods and organize data to minimize weaknesses of methods. | Requires MPO staff with the ability to apply HSM predictive method to conduct network screening or to understand this information provided by the State DOT. |

## Table 4. Network screening.

*Considerations.*

| | Basic | Intermediate | Advanced |
|---|---|---|---|
| Pros | Results are easily understood, low data requirements and technical expertise. | Results are easily understood, moderate data requirements and technical expertise. Accounts for exposure and severity. Compares similar facility types (based on urban/rural location, number of lanes, ADT). | Provides high level of confidence in improved safety outcome. Use of safety performance functions enables screening of all transportation projects for safety outcomes. Ranking by potential for safety improvement makes it possible to compare facilities of different types. |
| Cons | Does not account for exposure and favors sites with high traffic volume. | Practitioners have to develop familiarity with methods to understand the strengths and weaknesses of different methods and how this can influence results. Unless accounted for, regression to the mean (natural up and down fluctuation of crash frequency) may bias results. | High level of complexity and significant staff resources are required. |
| Considerations | The ranking on a statewide list will inevitably be different than on an MPO generated list of locations only in the region. If a significant number of high crash locations (segments or intersections) are not appearing on a State DOT list, or the numbers are low on an MPO-generated list, the agency should consider taking a proactive approach using the Systemic method. | *It is useful to combine multiple methods so as to minimize each method's respective weaknesses.* If a significant number of sites (segments or intersections) are not appearing on a State DOT list, or the numbers are low on an MPO-generated list, the agency should consider taking a proactive Systemic approach | DOTs may be able to provide MPOs with a list of locations using this type of analysis performed at the State level. State DOTs also may be able to provide safety performance functions by functional classification or intersection type to the MPO to support the MPO doing the analysis. For small MPOs the small data sample size may make it difficult to develop valid models. |

## Applying the Highway Safety Manual in Planning

The AASHTO Highway Safety Manual (HSM), first published in 2010, represents the culmination of 10 years of research and development by an international team of safety experts, academics, and practitioners. The HSM provides a set of tools and knowledge to support a science-based approach to quantifying safety. As a tool, the HSM provides the ability to incorporate meaningful safety metrics—crash frequency and severity—into an agency's program planning and project development processes, whether the project's purpose is driven by a particular safety concern or not.

When agencies are considering implementing projects or modifying policies, the HSM provides the ability to assess anticipated changes in crash frequency or severity, allowing explicit consideration of the safety impacts in addition to potential traffic operations and/or economic impacts. For example, in terms of corridor-specific plans, the HSM can assist with refinements to the plan by allowing planners and engineers to estimate the change in safety performance across different concepts and approaches considered for a corridor. For example, the HSM can be used to assess the influence of the type and frequency of intersections, driveways, parking, or median types on crash frequency for an urban or suburban arterial.

Whether the "purpose and need" is safety related or not, every project can benefit from applying the HSM in the development and evaluation of alternatives. When agencies include safety performance in planning, they are promoting longer-term approaches to support the reduction in the number and severity of crashes. The inclusion of safety performance in planning supports strategic investments where the impact is likely to be the highest.


(Source: AASHTO Highway Safety Manual Web site banner.)

## Network Screening Technical Resources

- AASHTO Highway Safety Manual.
- AASHTO Safety Analyst.
- FHWA Nine Proven Countermeasures.
- FHWA Crash Modification Factors Clearinghouse.
- FHWA CMFs in Practice.
- Integrating the HSM into the Highway Project Development Process.
- FHWA resources on countermeasures for addressing different crash types such as roadway departure, intersections, local and rural roads, bicycle, and pedestrian.

## Use of Safety Analyst Network Screening Tool in Project Prioritization

The Upper Valley Lake Sunapee Regional Planning Commission (RPC) in New Hampshire uses two safety criteria to rank projects in its Transportation Improvement Program:

- Crash history along the segment/intersection over past five years compared to other locations of that same type using the Safety Analyst network screening tool.
- Estimated efficacy of the proposed improvement in terms of fatality and serious injury reduction.

The New Hampshire DOT supports the four MPOs and five RPCs in the State by making Safety Analyst software available to them and assisting with safety analysis for project prioritization. All MPOs and RPCs in the State use these criteria but weight them differently based on their region's priorities.

## Champaign Urbana Urbanized Area Transportation Study Safety Criterion—TIP

For the TIP, up to 10 points, or 10 percent of the total available, can be awarded to each project on the basis of safety concerns. Project scores are awarded as follows:

- 10 points: Project site has a very high average crash frequency, very high average crash rate, and high average crash severity. The project has safety improvement as its prime objective.
- 8 points: Project site has a high average crash frequency, very high average crash rate, and high average crash severity. The project has safety improvement as its prime objective.
- 6 points: Project site has a high average crash frequency, high average crash rate, and moderate average crash severity. The project has safety improvement as its prime objective.
- 4 points: Project site has an above mean average crash frequency and above mean average crash rate. The project has safety improvement as a prime objective.
- 2 points: Provides some improvement to road user safety. Safety improvement is stated in the objectives.

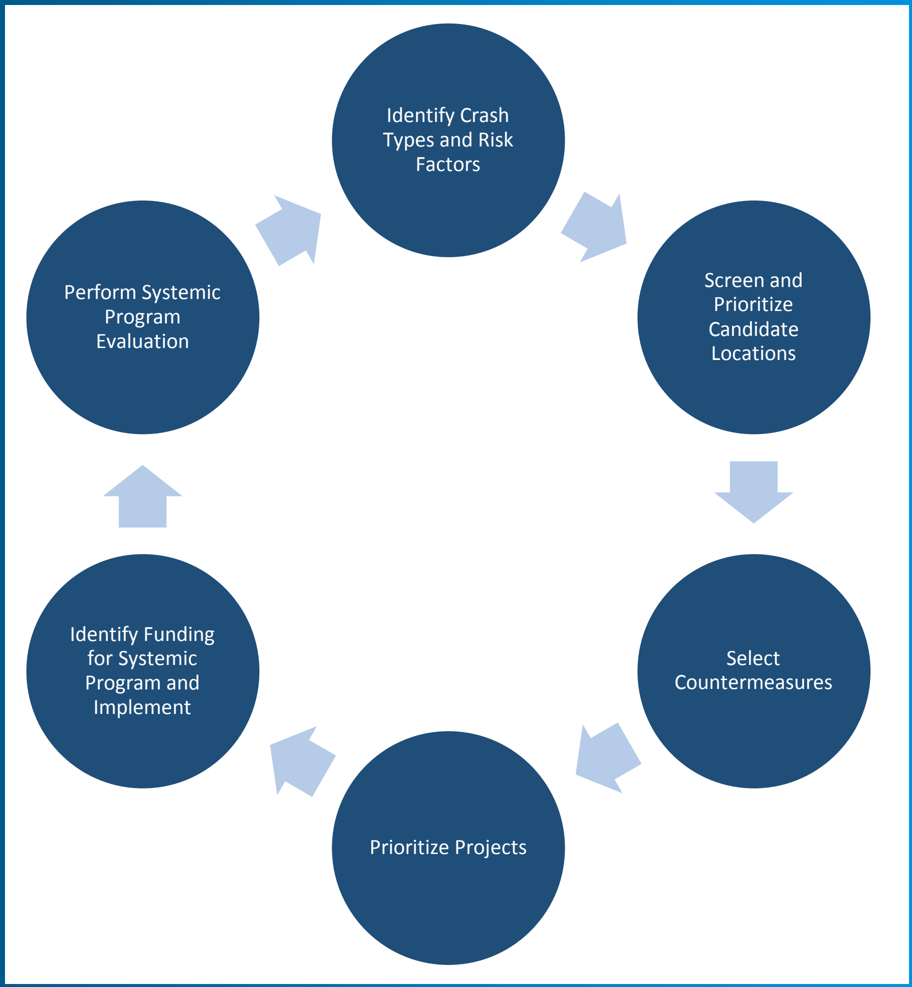
(Source: CUUATS Project Assessment Guidelines for Assignment of STP (U) Funds, September 2008.)

## 2. Systemic Approach

Systemic safety is a proactive approach to preventing crashes and may be a better approach than reacting to crash history for an MPO region that has lower frequency of severe crashes and fewer obvious locations with major safety problems. This approach (shown in the figure to the right) enables systemic safety elements to be integrated into all types of transportation projects so that safety is improved with every project. It provides an opportunity for MPO staff to recommend the addition of safety elements to a wide range of transportation projects and to progressively improve the system using proven effective countermeasures.

The basic objective of the systemic safety planning process is to identify candidates for safety investment based on risk factors. Candidate sites are identified by comparing the actual conditions of segments, curves, and intersections with a set of observed characteristics associated with the locations where the focus crash types actually occurred. The data-driven process identifies the observed characteristics (risk factors) associated with the focus crash type. The systemic safety planning process uses selected risk factors to differentiate one segment from another, one curve from another, and one intersection from another in order to prioritize these facilities and give higher priority to locations where there is greater potential for future severe focus crashes. The systemic safety planning process can be adapted to meet agency-specific needs or crash reduction goals, consistent with the data available. The systemic planning process produces results with minimal levels of data; however, greater levels of data support a more refined prioritization.

### Systemic Safety Process




(Source: safety.fhwa.dot.gov/systemic.)

## Table 5. Systemic.

*Sample criterion and analysis methods.*

| | Basic | Intermediate | Advanced |
|---|---|---|---|
| Sample Criterion | Points are awarded to all types of transportation projects that incorporate systemic safety countermeasures from a list of defined State or regional countermeasures in appropriate locations. | Points are awarded for projects on the list of higher risk locations defined by a systemic analysis that incorporate appropriate systemic safety countermeasures. | Points are awarded for projects on the list of higher risk locations defined by a *more detailed* systemic analysis that incorporate appropriate systemic safety countermeasures. |
| Analysis Method<br>*Problem Identification* | No original problem identification analysis performed. | Analysis of focus crash types and facilities using basic set of data (see table 6) to identify risk factors. Using network data identify locations with risk factors, which may or may not have crash history. | Analysis of focus crash types and facilities using more comprehensive set of data (see table 6) to identify risk factors. Using network data identify locations with risk factors, which may or may not have crash history. |
| Analysis Method<br>*Project Development* | For all types of transportation projects, ensure that systemic countermeasures appropriate for that type of facility are incorporated. Evaluate project proposals using a checklist of priority systemic countermeasures (e.g., retroreflective striping, signal backplates, medians and pedestrian crossing islands in urban and suburban areas, corridor access management, etc.). | Follow the approach defined in the Systemic Safety Project Selection Tool to conduct a systemic analysis with limited data: Identify focus crash types and risk factors, screen and prioritize candidate locations; select countermeasures; prioritize projects that may be standalone safety projects or safety elements to be integrated into general roadway projects. | Follow the approach defined in the Systemic Safety Project Selection Tool to conduct *systemic analysis using a larger set of data elements for analysis*: Identify focus crash types and risk factors, screen and prioritize candidate locations; select countermeasures; prioritize projects that may be standalone safety projects or safety elements to be integrated into general roadway projects. |

## Table 6. Systemic.

*Characteristics of approach.*

| | Basic | Intermediate | Advanced |
|---|---|---|---|
| Data Requirements | Defined policy for implementation of systemic countermeasures. Knowledge of proven low-cost systemic safety countermeasures, e.g., State Roadway Departure Plan or Intersection Plan or in State policies. | For the MPO to conduct its own Systemic analysis: System type (e.g., State, local); Crash type (e.g., road departure, right angle, head-on, rear end, turning); Facility type (e.g., freeway, expressway, arterial, or collector); Crash location type (e.g., urban versus rural, intersection versus. segment, tangent versus curve); Location characteristics (e.g., topography, intersection elements, segment elements). Alternatively, obtain systemic analysis results from the DOT for the MPO region. Knowledge of systemic safety countermeasures, potentially documented in a State DOT safety plan or policies. | For the MPO to conduct its own *more advanced* systemic analysis, *a larger set of data*: System type (e.g., State, local); Crash type (e.g., road departure, right angle, head-on, rear end, turning); Facility type (e.g., freeway, expressway, arterial, or collector); Crash location type (e.g., urban versus rural, intersection versus segment, tangent versus curve); Location characteristics (e.g., topography, intersection elements, segment elements); Crash roadway infrastructure and traffic volume data; Traffic volumes for segments and intersections. Ideally also: Roadway features (e.g., number of lanes, shoulder type and width, road edge features and quality, number and type of access, radius and superelevation of horizontal curves, density of horizontal curves, speed limit, speed differential between curves and tangents, medians, pavement condition and friction); Intersection features (e.g., number of approaches, skew, proximity to horizontal and vertical curves, number of approach lanes, signal timing, proximity to railroad crossing, traffic control devices, presence of street lighting, presence of commercial development). Knowledge of safety countermeasures, potentially documented in a State DOT safety plan or policies. |
| Complexity | Low. Basic knowledge of Systemic safety concepts needed. | Moderate level of familiarity with crash data and Systemic safety analysis methods. May be able to obtain Systemic analysis results from the DOT, which will reduce level of needed technical expertise by MPO. | Moderate *to high* level of familiarity with crash data and Systemic safety analysis methods. May be able to obtain Systemic analysis results from the DOT, which will reduce level of needed technical expertise by MPO. |
| Resources Needed | Staff will need to have or obtain basic understanding of Systemic safety concepts. | Knowledge of Systemic analysis methods, experience with or willingness to learn to how to use Systemic Safety Project Selection Tool or U.S. Road Assessment Program Tools. | Same as "Intermediate." |

## Table 7. Systemic.

*Considerations.*

| | Basic | Intermediate | Advanced |
|---|---|---|---|
| Pros | Systemic safety is a proactive approach to preventing crashes. This may be a better approach than reacting to crash history for an MPO that has a lower frequency of severe crashes and fewer obvious locations with major safety problems. This approach enables systemic safety elements to be integrated into all types of transportation projects so that safety is being improved with every project. Provides an opportunity for MPO staff to recommend the addition of safety elements to a wide range of transportation projects and to progressively improve the system using proven countermeasures. Using the systemic methods, a region will gain understanding of the top risk factors on its system and can more proactively target addressing them in projects. | Same as "Basic." | Same as "Basic." |
| Cons | Stakeholders may have difficulty understanding the proactive Systemic approach and it may be challenging to obtain support for these methods. | Stakeholders may have difficulty understanding the Systemic approach and it may be challenging to obtain support for these methods. MPOs may feel they do not have the expertise to conduct their own Systemic safety analysis—they may wish to use contractors for this or seek support from the State DOT. | Same as "Intermediate." |
| Considerations | Systemic integration of some countermeasures may require policy changes, such as a roundabout first policy for intersection reconstruction or corridor access management. It is important to coordinate with the State DOT as many agencies have systemic programs and can provide guidance on preferred systemic countermeasures. Systemic safety elements could include vehicle-to-infrastructure communications technology installed by DOTs. | Same as "Basic." | Same as "Basic." |

## Systemic Safety Technical Resources

- FHWA Systemic Safety Project Selection Tool.
- United States Road Assessment Program (usRAP).
- FHWA CMF Clearinghouse.
- FHWA Safety Resources.

## 3. Countermeasure-Driven Approach

This approach draws upon the body of knowledge of safety countermeasures that have been formally evaluated and proven to benefit transportation safety. The approach encourages sponsors of all types of transportation projects to integrate effective safety countermeasures as appropriate and ensure that projects with primary purposes other than safety also are contributing to improved regional safety outcomes.

**Table 8. Countermeasure-driven.**

*Sample criterion and analysis methods.*

| | Basic | Intermediate | Advanced |
|---|---|---|---|
| Sample Criterion | Provide points for projects that include one or more of the FHWA nine proven safety countermeasures or countermeasures in a State's Strategic Highway Safety Plan or regional safety plan. | Provide points for inclusion of appropriate proven effective safety countermeasures such as FHWA nine proven safety countermeasures, those with crash modification factors developed by the State, countermeasures defined in a State safety plan or identified in the HSM or CMF Clearinghouse. | Provide points for proposed transportation projects with forecasted safety improvement (estimated change in fatalities or serious injuries) using the Highway Safety Manual predictive method. |
| Analysis Method *Problem Identification* | This is a solution-driven approach that involves problem identification only as part of project development. | Same as "Basic." | Same as "Basic." |
| Analysis Method *Project Development* | Determine if any of FHWA nine proven safety countermeasures are appropriate, and if they are incorporated into project. Determine if project includes any countermeasures included in the State's Strategic Highway Safety Plan or a regional safety plan. | Identify crash types (e.g., intersection, roadway departure, left turn, rear-end, etc.), determine if any proven countermeasures (those with crash modification factors showing effectiveness) are appropriate to address safety problem, and determine if they are incorporated into project. Determine if project includes any countermeasures included in the State's Strategic Highway Safety Plan or a regional safety plan. | Identify crash types (e.g., intersection or roadway departure, left turn, rear-end, etc.), determine if any proven countermeasures are appropriate to address safety problem, and determine if they are incorporated into project. Determine if project includes any countermeasures included in the State's Strategic Highway Safety Plan or a regional safety plan. *Use the HSM predictive method to test proposed alternative(s) and quantify safety impacts.* |

## Table 9. Countermeasure-driven.

*Characteristics of approach.*

| | Basic | Intermediate | Advanced |
|---|---|---|---|
| Data Requirements | Crash data to identify crash factors at project locations. | List of approved proven effective countermeasures for which projects can obtain points. Crash data, including crash reports at project locations. | Detailed understanding of crash contributing factors; HSM predictive method supporting data which broadly includes roadway characteristics (e.g., number and width of lanes, presence of medians, bike lanes, sidewalks, shoulder width, and type), traffic volumes, and crash factors. |
| Complexity | Low level of expertise needed—familiarity with basic safety concepts and the nine FHWA proven safety countermeasures. | Moderate. Requires understanding of crash modification factors and familiarity with sources for proven effective countermeasures. Requires basic understanding of facility design and ability to identify opportunities to integrate safety countermeasures into all types of transportation projects. | Complex. Requires understanding of and ability to use HSM predictive methods. Tools are publicly available in spreadsheet format. The FHWA Interactive Highway Safety Design Model (IHSDM) applies the HSM predictive method. HSM trainings are available from FHWA. DOT districts may be able to provide analytical support. |
| Resources Needed | Staff who have or can gain technical knowledge of safety countermeasures and work with sponsors to discuss consideration and incorporation of safety countermeasures into all transportation projects as appropriate. | Same as "Basic." | Staff who have or can gain technical knowledge *of HSM analysis methods* and safety countermeasures. Staff who can work with sponsors to discuss consideration and incorporation of safety countermeasures into all transportation projects as appropriate. |

## Table 10. Countermeasure-driven. Considerations.

| | Basic | Intermediate | Advanced |
|---|---|---|---|
| Pros | Ensures quantifiable positive safety outcome by using proven effective countermeasures with known crash modification factors. Familiarizes project sponsors of all types of transportation projects with FHWA nine proven safety countermeasures and the concept of integrating proven effective countermeasures into projects. | Ensures quantifiable positive safety outcome by using proven effective countermeasures with known crash modification factors. Familiarizes sponsors of all types of transportation projects with the concept of integrating proven effective countermeasures into projects. *Ensures countermeasures are addressing known safety issues at project location.* | Employs HSM predictive method to estimate safety outcomes of roadway designs. Can be used to identify the safety impacts of many types of roadway projects, including those with a non-safety purpose and ensure that they are improving safety and not degrading safety. |
| Cons | The potential exists for project sponsors to try to integrate countermeasures where inappropriate for project context to obtain safety points during screening process. | Same as "Basic." | Significant knowledge is required to use HSM methods and MPOs may not have sufficient resources for this level of analytical complexity. |
| Considerations | Need sufficiently detailed project design information from project sponsors to conduct scoring. Need to ensure safety countermeasures are retained as project progresses through design refinements. Evaluation should be part of project implementation to determine if severe crashes decrease following implementation of the project (See sections 5 and 6). | Same as "Basic." | Same as "Basic." |

## Countermeasure-Driven Technical Resources

- FHWA Nine Proven Safety Countermeasures.
- FHWA Crash Modification Factors Clearinghouse.
- FHWA resources on countermeasures for addressing different crash types such as roadway departure, intersections, local and rural roads, bicycle, and pedestrian.
- AASHTO Highway Safety Manual.


Figure 3. Graphic. Federal Highway Administration nine proven safety countermeasures.

(Source: http://safety.fhwa.dot.gov/provencountermeasures/.)

Roadway Safety Rating

Up to a maximum of 1 point

☐ 0.5 points per safety improvement in one or more Department of Transportation identified high crash locations (up to 1 point)

☐ Pennsylvania Roadway Departure Improvement Program—the project must implement the specific identified safety improvement:

- Enhanced signs and markings for curves.
- Enhanced signs and markings for curves and high-friction surfaces.
- Centerline rumble strips.
- Edge line rumble strips or shoulder rumble strips.
- Wider shoulders/edge line rumble strips.
- Center and edge line pavement parkings.
- Alignment deliniation/lighting.
- High-friction surfaces.
- Guiderail relocatons/safety enhancements, utility pole removal/safety enhancements.
- Enforcement and education—alcohol related.
- Enforcement and education—speeding related.
- Enforcement and education—restraint related.
- Infrastructure improvements—speeding related.
- Install cable median barrier.

☐ Pennsylvania Intersection Safety Improvement Program—the project must implement the specific identified safety improvement, STOP, SIGNAL, LEFT TURN, PED or SPEED

☐ 0.5 points per incorporated Federal Highway Administration proven safety countermeasure:

- Roundabouts.
- Access management.
- Signal backplates with retro-reflective borders.
- Longitudinal rumble strips and stripes on two-lane roads.
- Enhanced delineation and friction for horizontal curves.
- Safety edge.
- Medians and pedestrian crossing islands in urban and suburban areas.
- Pedestrian hybrid beacons.
- Road diets.

Transit Safety Priority Rating

Up to 1 point is awarded for transit assets that exceed their useful life.

Figure 4. Chart. Delaware Valley Regional Planning Commission Transportation Improvement Program safety criteria.

(Source: Appendix F: DVRPC TIP Project Benefit Criteria.)

## 4. Complete Streets Approach

According to the National Complete Streets Coalition, Complete Streets are those designed and operated to enable safe access and travel for all users. Pedestrians, bicyclists, motorists, transit users, and travelers of all ages and abilities will be able to move along the street network safely. Typical elements that make up a Complete Street include sidewalks, bicycle lanes (or wide, paved shoulders), shared-use paths, designated bus lanes, safe and accessible transit stops, and frequent and safe crossings for pedestrians, including median islands, accessible pedestrian signals, and curb extensions. The idea is to build or retrofit the transportation system to reduce speeds, reduce conflicts and separate facilities consistent with the context.

Promoting sustainable urban development can have a strong and positive relationship with traffic safety. This comes from two key safety issues: exposure and risk. Sustainable urban development practices can a) reduce exposure by preventing the need for vehicle travel, thus preventing a crash before a trip would even begin; and b) diminish risk by encouraging safer vehicle speeds and prioritizing pedestrian and bicyclist safety. (Cities Safer by Design: Urban Design Recommendations for Healthier Cities, Fewer Traffic Fatalities, World Resources Institute, 2016.)

It is not recommended that a Complete Streets criterion be used as the only safety criterion, but be used in combination with a dedicated, quantifiable safety criterion, such as described in the Network Screening, Countermeasure-Based, or Systemic approaches. It is critical to ensure that good quality design speed management and consideration of context are part of any Complete Street project that receives safety points. For example, signing a shoulder as a bike lane on a rural roadway with a speed limit of 45 miles per hour should not be awarded Complete Streets safety points.

## Table 11. Complete streets.

*Sample criterion and analysis approach.*

| | Basic | Intermediate | Advanced |
|---|---|---|---|
| Sample Criterion | Projects with well designed Complete Streets elements (e.g., facilities for pedestrians and bicyclists, and speed management elements) receive safety points on project scoring system. | Projects addressing known safety issues and including comprehensive Complete Streets elements (e.g., facilities for transit, pedestrians and bicyclists and speed management elements) receive points on project scoring system. More points are provided when project addresses identified safety issues based on problem analysis. More points are provided for separated bicycle lanes, wider sidewalks and speed management to 25 miles per hour or below. | Projects addressing known safety issues and including comprehensive Complete Streets elements receive points on project scoring system. More points are provided for separated bicycle lanes and wide sidewalks and speed management to 25 miles per hour or below. More points are provided when project addresses identified safety issues based on problem analysis. *More points are provided when corridor provides connectivity/fills gaps in bicycle/pedestrian network. More points are awarded when HSM predictive method is used to estimate safety benefits.* |
| Analysis Method *Problem Identification* | Identify corridors with potential for Complete Streets design approach. If a Complete Streets policy exists in the region or municipality all streets may be reviewed for a Complete Streets approach (e.g., all roads except limited access roadways where bicycles and pedestrians are prohibited). | *Identify corridors with safety issues, particularly a history of bicycle and pedestrian crashes, gap in pedestrian/bicycle network,* and potential for Complete Streets design approach. If a Complete Streets policy exists in the region or municipality all streets may be reviewed for a Complete Streets approach (e.g., all roadways except limited access roadways where bicycles and pedestrians are prohibited). | Same as “Intermediate.” |
| Analysis Method *Project Development* | Ensure project includes Complete Streets components. Ensure project includes proven effective safety countermeasures. | Ensure project addresses location with crash problems or a gap in a nonmotorized network and includes comprehensive Complete Streets components. Ensure project addresses identified crash types in project location using proven effective countermeasures. | Ensure project addresses location with crash problem or gap in a nonmotorized network and includes Complete Streets components. Ensure project addresses identified crash types in project location using proven effective countermeasures. *Use HSM predictive method or crash modification factors to ensure project design is optimized for safety given the context (e.g., appropriate lane widths, pedestrian/ bicycle signals, and separated bicycle lanes).* |

## Table 12. Complete streets.

*Characteristics of approach.*

| | Basic | Intermediate | Advanced |
|---|---|---|---|
| Data Requirements | Crash and roadway data in geospatial format. | Crash and roadway data in geospatial format. Data on crash types occurring in locations where projects are proposed. Ideally obtain information from a Road Safety Audit conducted as part of problem identification and project development. | Crash and roadway data in geospatial format. Data on crash types occurring in locations where projects are proposed. *Infrastructure and operations data, including existence of sidewalks and bike lanes, lane widths, ADT, traffic speeds, & percentage truck traffic.* Ideally obtain information from a Road Safety Audit conducted as part of problem identification and project development. |
| Complexity | Low. Requires understanding of Complete Streets and basic traffic safety concepts. Requires basic understanding of data management in spatial/GIS context. To award points for a project addressing a safety problem requires some understanding of how to apply safety countermeasures to address defined safety problems. | Moderate. Requires understanding of Complete Streets and traffic safety concepts. Requires understanding of data management in spatial/GIS context. To award points for a project addressing a safety problem requires understanding of how to apply safety countermeasures to address defined safety problems. *May involve Road Safety Audit skills.* | High. Requires advanced understanding of traffic safety theory and data manipulation. *Ideally, involves use of HSM methods to test design alternatives of proposed projects and evaluate safety impacts.* To award points for a project addressing a safety problem requires understanding of how to apply safety countermeasures to address defined safety problems. May involve Road Safety Audit skills. |
| Resources Needed | MPOs with staff capable of conducting GIS analysis can complete this task with a moderate level of effort. MPOs can obtain crash data from the State DOT. | Requires MPO staff with ability to obtain and work with crash data from statewide crash database to analyze crash factors at project location. Alternatively MPOs may be able to obtain this information from the State DOT. | Requires MPO staff with ability to obtain and work with crash data from statewide crash database and calculate crash rates on segments and at intersections, using crash and ADT data. Requires MPO staff with the ability to apply HSM network screening/predictive methods to estimate safety outcome or to obtain this information from the State DOT. |

## Table 13. Complete streets.

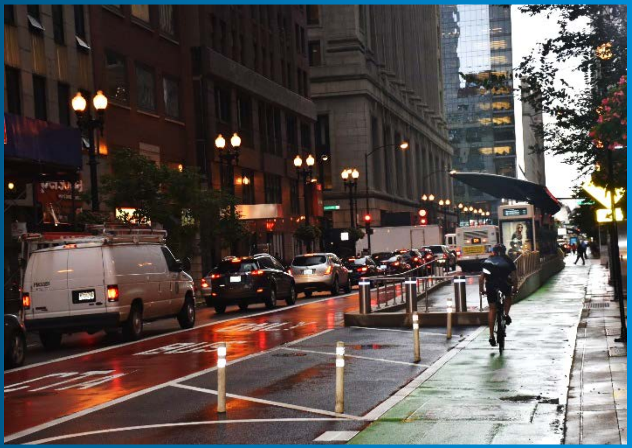
*Considerations.*

| | Basic | Intermediate | Advanced |
|---|---|---|---|
| Pros | Supports implementation of Complete Streets Policy. Use of proven effective countermeasures will result in high confidence of improved safety outcomes. Is a proactive approach to development of a "safe system." | Supports implementation of Complete Streets Policy. *Addresses known crash problems.* Use of proven effective countermeasures will result in high confidence of improved safety outcomes. Is a proactive approach to development of a "safe system." *Addresses creation of a nonmotorized network and filling of gaps.* | Supports implementation of Complete Streets Policy. Uses HSM methods to quantify safety benefits of proposed projects. |
| Cons | Does not necessarily address known crash history but depends on Complete Streets designs to confer safety benefits. | Depends on Complete Streets designs to confer safety benefits. | Requires complex HSM analysis skills. |
| Considerations | Is context sensitive and requires skilled judgment in awarding of points to ensure all safety benefits will be realized. Because a number of elements will not be formally defined until the project enters the design phase, add language to project description to ensure proven effective safety countermeasures are integrated during detailed design phase. May require understanding of permitted designs per State design manuals. | Same as "Basic." | Because a number of elements will not be formally defined until the project enters the design phase, add language to project description to ensure proven effective safety countermeasures are integrated during detailed design phase. May require understanding of permitted designs per State design manuals. |

## Complete Streets Technical Resources

- FHWA Road Diets Web site.
- FHWA Crash Modification Factors Clearinghouse.
- FHWA Resources on Bicycle and Pedestrian Safety.
- AASHTO Highway Safety Manual.
- National Complete Streets Coalition.
- NACTO Urban Street Design Guide.
- NACTO Urban Bikeway Design Guide.
- NACTO Transit Street Design Guide.
- Safer Streets, Stronger Economies: Complete Streets Project Outcomes from Across the Country: Complete Streets Project Outcomes from Across the Country.

### Chicago Complete Street



(Source: Cambridge Systematics, Inc.)

| Goal: Accessibility | | |
|---|---|---|
| Highway | Complete Streets features – 5, 3, or 0 points | Degree to which project delivers safety / accessibility benefits for all modes (ADA improvements, improved bike facilities, etc.) – total population first, then EJ population – per mile benefits<br>Significant features = 5 points<br>Moderate features = 3 points<br>Not applicable = 0 points |

Figure 5. Graphic. Baltimore Metropolitan Council Complete Streets criterion.

(Source: Maximize 2040 Appendix F: Project Evaluation and Scoring.)

## 5. Mode Shift Approach

The philosophy of this approach is that projects that shift person miles traveled from auto to other modes such as transit, which has a much lower severe crash frequency than autos, or to bike or pedestrian modes if safer infrastructure exists, will result in lower risk of crashes and less risk of injury. The idea is to build or retrofit the transportation system to reduce speeds, reduce conflicts, and separate facilities consistent with the context.

Safer cities tend to be ones with extensive public transportation, good conditions for walking and cycling, and fewer cars on the road driving short distances at safer speeds. Data confirms there are fewer fatalities in places with fewer vehicle miles traveled and those promoting mass transport, walking and cycling, thus reducing overall exposure. (Saving Lives with Sustainable Transport, World Resources Institute, 2012.)

It is not recommended that a Mode Shift criterion be used as the only safety criterion, but be used in combination with a dedicated, quantifiable safety criteria, such as described in the Network Screening, Countermeasure Based or Systemic approaches. It is important that projects not only reduce VMT but also provide safe alternatives such as improved transit, separated bike lanes, and sidewalks.

(Source: PhotoDisc Inc.)

## Table 14. Mode shift.

*Sample criterion and analysis methods.*

| | Basic | Intermediate | Advanced |
|---|---|---|---|
| Sample Criterion | Award safety points for projects that improve safe travel options for nonauto modes and reduce VMT. For example, a transit project that will generate a mode shift from auto to transit would receive safety points. | Award safety points for projects that improve safe travel options for nonauto modes and reduce VMT, based on travel demand model results. For example a transit project that will generate a mode shift from auto to transit would receive safety points. *Ideally the mode shift is demonstrated by travel demand model outputs, but this also can be determined using professional judgment for a more basic approach.* | Award safety points for projects that improve safe travel options for nonauto modes and reduce VMT, based on *advanced* travel demand model results. For example a new separated bike lane/sidewalk project along a corridor that will generate a mode shift from auto to nonmotorized modes would receive safety points. Ideally the mode shift is demonstrated via advanced travel demand model outputs but it also can be determined using professional judgment for a more basic approach. |
| Analysis Method<br>*Problem Identification* | It is known that transit has a far lower crash rate than auto. For bicycle and pedestrian modes, if trips are made on safer infrastructure such as protected bike lanes or sidewalks, the severe crash rate will be low. Therefore, fatal and serious injury crashes can be reduced by shifting more people to modes of transportation other than auto that have a better safety profile. | Same as "Basic." | Same as "Basic." |
| Analysis Method<br>*Project Development* | Each project will be analyzed for its anticipated impact on shifting travel to modes other than auto. The safety of the mode to which travel will be shifted also would be considered. For the nonauto modes, it is important to have appropriate transit stops and transit access, separated bike lanes and walkways, and reduced travel speeds. For example, a Complete Street project that adds dedicated bicycle and pedestrian infrastructure and improves conditions for transit would get higher points because of some anticipated shift of VMT to and the safety profile of the improved nonauto modes. All transit projects would obtain points under this measure as transit has a dramatically lower crash rate than auto transport. | Each project will be analyzed for its anticipated impact on shifting travel to modes other than auto *using the travel demand model as possible* for transit and professional judgment for bicycle and pedestrian projects. The safety of the mode to which travel will be shifted also would be considered. For example, a Complete Street project that adds dedicated bicycle and pedestrian infrastructure and improves conditions for transit would get points because of some anticipated shift of VMT to the improved nonauto modes. All transit projects would obtain points under this measure as transit has a dramatically lower crash rate than auto transport. | Each project will be analyzed for its anticipated impact on shifting travel to modes other than auto *using advanced travel demand model outputs, including those for bicycle and pedestrian modes*. The safety of the mode to which travel will be shifted also would be considered. For example, a Complete Street project that adds dedicated bicycle and pedestrian infrastructure and improves conditions for transit would get points because of some anticipated shift of VMT to the improved nonauto modes. All transit projects would obtain points under this measure as transit has a dramatically lower crash rate than auto transport. |

## Table 15. Mode shift.

*Characteristics of approach.*

| | Basic | Intermediate | Advanced |
|---|---|---|---|
| Data Requirements | Estimates of change in VMT that will be generated by a project, based on project mode type and sketch methods (e.g., a transit project is assumed to reduce auto VMT and increase transit VMT, although the scale is unknown). Information on bicycle/ pedestrian aspects of project such as type of bike lane, vehicle speeds, extent of pedestrian safety treatments such as medians and bulb outs to reduce crossing distance. | Travel demand model with both roadway and transit networks. Information on bicycle/ pedestrian aspects of project such as type of bike lane, vehicle speeds, extent of pedestrian safety treatments such as medians and bulb outs to reduce crossing distance. | Travel demand model with roadway, transit, *bicycle, and pedestrian networks that can isolate the mode shift for an individual project*. Information on bicycle/pedestrian aspects of project such as type of bike lane, vehicle speeds, extent of pedestrian safety treatments such as medians and bulb outs to reduce crossing distance. |
| Complexity | Low level of knowledge required to identify modes that would reduce VMT. | Moderate. Planners will need to coordinate with travel demand modelers to determine VMT impacts of proposed projects and mode shift to transit. | Moderate. Planners will need to coordinate with travel demand modelers to determine VMT impacts and mode shift potential (to transit, *bicycle, or pedestrian modes*) of proposed projects. |
| Resources Needed | Knowledge of anticipated mode shifts resulting from various project types. Professional expertise and familiarity with nonmotorized design resources will be needed in evaluating bicycle and pedestrian infrastructure safety. | Travel demand model with both roadway and transit networks that can isolate mode shift by project. Professional expertise and familiarity with nonmotorized design resources will be needed in evaluating bicycle and pedestrian infrastructure safety. | Travel demand model with roadway, transit, *bicycle, and pedestrian networks* that can isolate the mode shift by project. Professional expertise and familiarity with nonmotorized design resources will be needed in evaluating bicycle and pedestrian infrastructure safety. |

Table 16. Mode shift.

*Considerations.*

| | Basic | Intermediate | Advanced |
|---|---|---|---|
| Pros | Provides a way to account for the multimodal safety impacts of investment decisions and acknowledge the safety benefits of modes with lower crash rates. | Same as "Basic." | Same as "Basic." |
| Cons | This approach is based on sketch methods. It is unclear when self-driving vehicle technology will reduce the benefits currently gained by reducing auto VMT. | Many travel demand models include roadway and transit networks and not bicycle and pedestrian networks. Therefore mode shift may only be able to be formally quantified for transit projects if the model does not include bicycle and pedestrian networks. It is unclear when self-driving vehicle technology will reduce the benefits currently gained by reducing auto VMT. | Addition of bicycle and pedestrian networks to travel demand models is an emerging area and a relatively small number of agencies have taken this stop, although a number of agencies are in the process of integrating nonmotorized networks into their models. It is unclear when self-driving vehicle technology will reduce the benefits currently gained by reducing auto VMT. |
| Considerations | Given the emerging advances in automated/ connected vehicles and safety benefits, this criterion may be most appropriate for use in shorter-term TIP prioritization as the landscape in 20 years is unknown. | Requires that regional mode choice model include a transit network to isolate mode shifts; most MPOs are only in the early stages of adding nonmotorized networks. Given the emerging advances in automated/connected vehicles and safety benefits, this criterion may be most appropriate for use in shorter-term TIP prioritization as the landscape in 20 years is unknown. | Requires that regional mode choice model include transit, *bicycle and pedestrian* networks to isolate mode shifts; most MPOs are only in the early stages of adding nonmotorized networks. Given the emerging advances in automated/connected vehicles and safety benefits, this criterion may be most appropriate for use in shorter-term TIP prioritization as the landscape in 20 years is unknown. |

## Mode Shift Technical Resources

- FHWA Nine Proven Countermeasures.
- FHWA Crash Modification Factors Clearinghouse.
- FHWA resources on countermeasures for addressing different crash types (e.g., roadway departure, urban/rural, intersection).
- AASHTO Highway Safety Manual.
- Route Infrastructure and the Risk of Injuries to Bicyclists: A Case Crossover Study.
- Measuring the Street.
- Saving Lives with Sustainable Transport.
- Cities Safer by Design.
- The Hidden Traffic Safety Solution: Public Transportation.

## 6. Benefit-Cost Analysis

This approach develops a single benefit-cost analysis (BCA) measure to quantify whether the benefits outweigh the costs of a project, including safety as an element of that analysis. The benefits and costs of safety can be estimated from crash frequency and severity as calculated in previous approaches (i.e., Network Screening, Countermeasure-Based). BCA of only safety projects could be conducted as well although this may occur for only safety-specific projects such as those in the Highway Safety Improvement Program.

**Table 17. Benefit-cost analysis.**

*Sample criterion and analysis methods.*

| | Basic | Intermediate/Advanced |
|---|---|---|
| Sample Criterion | Highest points are awarded for benefit-cost ratios in excess of a high threshold as determined by the MPO, for example, over 5:1. Cost ratios between a middle and high threshold as determined by the MPO, potentially between 2:1 and 5:1. Points are awarded for lower benefit-cost ratios >1:1 and <a middle threshold, potentially 2:1. | Same as "Basic." |
| NOTE | Both levels have the same sample criterion. The difference will be the level of complexity of the benefit-cost analysis methods that develop the BCA value. | Same as "Basic." |
| Analysis Method *Problem Identification* | Potential safety benefits can be estimated using CMFs and observed crash conditions. | Potential safety benefits can be estimated using CMFs and observed crash conditions, *or using the HSM predictive method to account for changes in infrastructure or traffic volume*. |
| Analysis Method *Project Development* | Project development could result from any of the other methods discussed in this guide, including Complete Streets, Systemic, Network Screening, Countermeasure-Driven, or Mode Shift. The critical element here is to ensure the project will benefit safety by reducing fatalities and serious injuries, which can be monetized in terms of the value of a statistical life and the cost of a severe injury. | Same as "Basic." |

## Table 18. Benefit-cost analysis.

*Characteristics of approach.*

| | Basic | Intermediate/Advanced |
|---|---|---|
| Data Requirements | Data to quantify safety benefits (reduction in fatalities and serious injuries) and project capital and operations costs. Data would include crash modification factors, forecasted mode shift, and value of a statistical life/injuries. | Data to quantify safety benefits: reduction in fatalities and serious injuries and costs of a project. Data such as crash modification factors, forecasted mode shift and value of a statistical life/injuries. The BCA would likely include other monetized benefits such as travel-time savings but could calculate only safety benefits and costs. If safety deteriorates as a result of the project that should be noted separately. |
| Complexity | Moderate complexity. Requires staff knowledge of how to monetize transportation benefit streams over time, and economics methods such as discounting dollars in future years. | Same as "Basic." |
| Resources Needed | Knowledge of benefit-cost analysis methods. Ability to use crash modification factors to forecast lives saved and injuries prevented. Alternatively, the ability to forecast mode shift. | Knowledge of benefit-cost analysis methods. Ability to use crash modification factors to forecast lives saved and injuries prevented. Potentially travel demand model with relevant networks to forecast mode shift among project types, i.e., auto and transit, bicycle or pedestrian. |

## Table 19. Benefit-cost analysis.

*Considerations.*

| | Basic | Intermediate/Advanced |
|---|---|---|
| Pros | This single measure quantifies whether the benefits outweigh the costs of a project, inclusive of safety. Benefit-cost analysis of only safety could be conducted as well, although this would likely occur primarily for safety-specific projects such as those in the HSIP program. | Same as "Basic." |
| Cons | Requires moderate level of technical knowledge by staff. Because the value blends benefits and costs from several sources, it is possible that the project could have negative safety benefits and still result in a positive BCA. The objective is to never have a project that degrades safety and this method could obscure negative safety impacts. Stakeholders may not understand the technical methods involved in BCA. Benefit-cost analysis involves a set of assumptions and some level of judgment and that can be biased. | Requires moderate level of technical knowledge by staff. If HSM methods are used, requires high level of staff capability. Because the value blends benefits and costs from several sources, it is possible that the project could have negative safety benefits and still result in a positive BCA. The objective is to never have a project that degrades safety. Stakeholders may not understand the technical methods involved in BCA. |
| Considerations | A multidimensional BCA alone is likely not sufficient to account for the safety impacts of a project—or the safety elements should be called out separately. Additionally, this method takes into account only aspects that can be quantified and monetized. Other qualitative aspects of a project should be accounted for separately. | Same as "Basic." |

## Benefit-Cost Analysis Technical Resources

- FHWA Nine Proven Countermeasures.
- FHWA Crash Modification Factors Clearinghouse.
- FHWA resources on countermeasures for addressing different crash types.
- AASHTO Highway Safety Manual.
- FHWA HSIP Manual.
- TRB Benefit Cost Analysis Committee Web site.
- U.S. DOT memorandum on the Value of a Statistical Life.

### San Diego Association of Governments

Safety is included in the San Diego Association of Governments (SANDAG) cost effectiveness criterion which carries 8 to 35 percent of the scoring weight for various modal categories. The cost effectiveness criterion for highway corridors and transit incorporates safety from the perspective of VMT's relationship to crashes. When a future scenario was run to test the results of a project VMT was considered. The current crash rate for that type of facility was used in future calculations. Since the rate of crashes/VMT was held constant, when VMT increased the safety profile of the project would deteriorate. In the case of a transit project for which VMT would decrease, then safety would improve. While analyses such as the project cost effectiveness criterion attempt to capture the economic effects of the projects as comprehensively as possible, such analyses may not fully reflect the importance of individual factors to the project prioritization process. As a result, some components of the project cost effectiveness criterion also are reflected in other evaluation criteria to capture the relative importance of these factors. In addition the MPO awards points for the crash rate at the project location as compared to the state crash rate for that type of facility.

# 4.0 Ensuring Projects Maintain Safety Elements during Project Development Process

One important challenge to recognize is that even with a good project prioritization process incorporating safety, some project safety elements are considered design decisions. As resources are constrained, there may be pressure to value engineer or simplify projects to reduce cost, which results in a risk that safety elements could be eliminated. Therefore, an added facet of ensuring the transportation system gets progressively safer is making sure that safety elements of projects actually get built.

Metropolitan Planning Organization (MPO) staff are encouraged to monitor project development and participate in meetings to ensure projects are built with the same specifications that were included when they were rated for safety as part of the project prioritization process. While a few MPOs do participate in project development meetings, or at least National Environmental Protection Act (NEPA) meetings, most do not. Usually the assumption is that when municipalities or the State Department of Transportation (DOT) take over the design and construction of projects, they incorporate the latest safety elements and standards during implementation of the project. In some cases a DOT team reviews every project in the State Transportation Improvement Program (STIP) for safety, which is a good process, but should not preclude the MPO monitoring the development process of projects in its region to make sure the safety elements are retained. MPOs are encouraged to be more involved in project development to ensure projects are designed and built to provide the safest transportation solution possible. If modifications of projects occur during final design, then the MPO can be a partner in making sure any changes have a net safety benefit and do not degrade safety.

It is critical to recognize that all transportation projects have the potential to improve safety. Planners must continually reinforce with project sponsors that safety is a major aspect of all projects, not only safety-specific projects. For projects to be the safest possible, safety must be considered starting in the early project development stages, not as a step late in the design phase. Sustained emphasis on safety throughout the design process is critical to ensure that safety elements do not get cut out along the way and that any changes benefit multimodal safety.

## MPOs Involved in Project Development

CUUATS participates in the preliminary design process and attempts to ensure that safety elements are carried through to construction.

Lexington Area MPO staff meet with traffic engineers on a regular basis. This allows for the MPO staff to provide technical input at the project design phase for many projects. MPO staff are very educated on the needs related to each project. When the project gets to the Transportation Improvement Program (TIP) stage, planners are able to communicate those needs to engineering staff. The MPO participates in semi-monthly meetings of the Transportation Project Coordination Team (including City of Lexington and Kentucky DOT), which allows for discussion of TIP projects and the elements of those projects, including safety elements, that are to be incorporated.

# 5.0 Evaluation of Projects for Safety Outcomes

As noted in the Statewide and Nonmetropolitan Transportation; Metropolitan Transportation Planning Final Rule, as part of their Metropolitan Transportation Plans (MTP), Metropolitan Planning Organizations (MPO) will need to submit a system performance report, which will document progress achieved toward meeting established targets in the national goal areas including safety. (Statewide and Nonmetropolitan Transportation Planning; Metropolitan Transportation Planning Final Rule. Federal Register /Vol. 81, No. 103 / Friday, May 27, 2016.) MPOs will either set annual safety targets or support annual State targets. Progress in reducing fatalities and serious injuries will need to be tracked more closely in the future to enable the required reporting. While in a few cases, MPOs regularly conduct before and after studies of safety outcomes for projects, this is the exception. States are more likely to do so for safety-specific projects funded by the Highway Safety Improvement Program (HSIP). However, the Federal performance management requirements will likely serve to encourage more analysis of safety outcomes. MPOs are encouraged to move toward establishment of processes to evaluate the safety impacts of all projects. This information will be important to understand which projects are resulting in the best outcomes for the cost and especially to ensure that certain project types are not degrading safety. As future project prioritization cycles are undertaken this will help States and regions have a better understanding of what projects are effective at reducing fatalities and serious injuries within their transportation context.

(Source: Cambridge Systematics, Inc.)

## Evaluation Plan Development

Well-designed evaluations reduce agency reliance on professional judgment by providing quantitative information on the impacts of highway safety improvements. Evaluation plans should always be considered prior to implementing any project or program.

The level of detail will depend upon the scope and complexity of the project or program. Following are typical steps in developing an evaluation plan:

- Write a statement defining the purpose(s) of the evaluation.
- Define the target population (e.g., facility, crash types, etc.).
- Clearly state goals, objectives, and performance measures.
- Define data needs based upon performance measures.
- Determine budget, staff, materials, and other resource needs.
- Determine what method(s) will be used for collecting the information.
- Identify an evaluation timeline and milestones.
- Identify the type of evaluation(s) and analyses to be used (e.g., design and combination of quantitative and qualitative analyses).

Rather than being considered an integral part of the performance-based planning process, evaluations are often an afterthought. As a result, the opportunity to collect critical baseline data may be lost, thereby compromising the effectiveness of the evaluation. Agencies should consider establishing evaluation guidelines to reinforce their commitment to evaluation, provide consistency, and improve the quality of evaluations.

(Source: Highway Safety Improvement Program Manual.)

# 6.0 Project Information Needed for Safety Prioritization Process

To ensure sufficient information is provided to enable rating projects based on safety, Metropolitan Planning Organizations (MPO) may wish to modify sponsor submission forms to increase the information related to safety provided. Below are elements they may wish to request based on which method they anticipate using. These elements are to be used as a guide and may not represent every element that could be requested. The MPO may obtain some elements on behalf of the project sponsor. The elements requested by sponsors in the project submission form will depend on:

- Criterion used for prioritization by MPO.
- Phase of planning process (i.e., Metropolitan Transportation Plan or Transportation Improvement Program).
- Analysis/calculations the MPO will perform to enable rating of each project.
- Information available from the State Department of Transportation (DOT).
- Number of projects for which rating will need to occur.
- Extent to which project sponsors are informed of tools to help them develop a submission (i.e., knowledge of information on safety countermeasures).

Table 20 details the data needed for each type of prioritization method, to help inform MPOs as they request information from project sponsors or the DOT, or prepare to conduct their own analysis.

Table 20. Data needs to inform safety rating.

| Criterion Type | Network Screening | | | Systemic | | | Countermeasure-Driven | | | Complete Streets | | | Mode Shift | | | Benefit-Cost Analysis | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Data Element** | B | I | A | B | I | A | B | I | A | B | I | A | B | I | A | B | I/A |
| Number of fatal and serious injuries for past three to five years in project location (along segment or at intersection) in geospatial format (GIS) | ● | ● | ● | | ● | ● | ● | ● | ● | | ● | ● | | | | ● | ● |
| Average Daily Traffic | | ● | ● | | | ● | | | ● | | | | | | | | ● |
| Roadway characteristics (e.g., number of lanes, functional class, lighting, medians, bike lanes, sidewalks, shoulder width) | | ● | ● | | ● | ● | | | ● | ● | ● | ● | | | | | ● |
| Collision factors for crashes occurring in past three to five years (i.e., roadway departure, intersection, bicycle, pedestrian, light condition) | | ● | ● | | ● | ● | ● | ● | ● | | ● | ● | | | | | |
| Safety countermeasures integrated into project (see FHWA Nine Proven Countermeasures, Crash Modification Factors Clearinghouse and other FHWA safety guidance) | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Anticipated mode shift from auto VMT to transit, bike, pedestrian modes | | | | | | | | | | | | | ● | ● | ● | | |
| Anticipated fatality/injury reduction from project based on Crash Modification Factors or HSM predictive method | | | ● | | | | | ● | ● | | | ● | | | | ● | ● |

# 7.0 Prioritizing Safety—Putting the Steps into Action

To improve the process of using safety as a project prioritization criterion, consider the checklist below.

- ☐ Evaluate current prioritization process for safety:
  - What criteria currently are used to evaluate projects for safety?
  - What are the pros/cons of current criteria?
  - Are safety criteria applied to all project types?
  - What is the level of priority for safety as reflected by the criteria weighting?
- ☐ Scan potential enhanced approaches in section 3 to determine which seem desirable and potentially feasible. Seek to use most advanced method possible.
- ☐ Review table 20 for required data for potential prioritization approach(es).
- ☐ If a desired approach requires data or technical skills not possessed by the Metropolitan Planning Organization (MPO), have a discussion with the State Department of Transportation (DOT) safety engineer or DOT District safety representative about data and analytical support the DOT can provide.
- ☐ Ask the DOT about safety training available, such as on general traffic safety concepts or AASHTO Highway Safety Manual Methods.
- ☐ Obtain the State's Strategic Highway Safety Plan to understand how MPO processes/plans can be aligned with State strategies.
- ☐ Propose new safety criterion/criteria for next Metropolitan Transportation Plan or Transportation Improvement Program process and reconsider criteria weighting.
- ☐ Test application of the new criterion.

# A. Glossary

ADT— average daily traffic

CMAQ— congestion mitigation and air quality program

HSM— Highway Safety Manual

MPO—Metropolitan Planning Organization

MTP—Metropolitan Transportation Plan

NEPA— National Environmental Protection Act

PBPP—Performance Based Planning and Programming

RSA—Road Safety Audit

SHSP—Strategic Highway Safety Plan

STBG—Surface Transportation Block Grants

STIP—State Transportation Improvement Program

TIP—Transportation Improvement Program

TMA—Transportation Management Area

## FHWA, Office of Planning, Environment, and Realty

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