Linking Transportation Asset Management, Transportation Performance Management, and Performance-Based Planning and Programming

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16. Abstract This document examines the interface of transportation asset management, transportation performance management, and performance-based planning and programming. All three create synergies that focus upon how short-term performance contributes to long term strategies to achieve national goals for safety, asset management, congestion relief, freight mobility, and resilience.			
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Glossary

Annual Consistency Determination Documents mean documents a State Department of Transportation (State DOT) uses to demonstrate development and implementation of a Transportation Asset Management Plan (TAMP) as described in 23 CFR 515.13(b).

Asset Management means, for purposes of title 23, U.S.C., a strategic and systematic process of operating, maintaining, and improving physical assets, with a focus on both engineering and economic analysis based upon quality information, to identify a structured sequence of maintenance, preservation, repair, rehabilitation, and replacement actions that will achieve and sustain a desired state of good repair (SOGR) over the life cycle of the assets at minimum practicable cost. (23 U.S.C. 101(a)(2) and 23 CFR 515.5)

Baseline Performance Period Report refers to the Transportation Performance Management (TPM) report referenced in 23 CFR 490.107(b)(1) in which State DOTs shall submit baseline condition and performance information by October 1st of the first year in a performance period and every 4 years thereafter baseline.

Complete Street – A street that is safe, and feels safe, for everyone using the street. Complete Streets standards or policies are those that ensure the safe and adequate accommodation of all users of the transportation system, including pedestrians, bicyclists, personal conveyance and micromobility users, public transportation users, children, older individuals, individuals with disabilities, motorists, and freight vehicles.

Complete Streets Design Model – A complete streets design model prioritizes safety, comfort, and connectivity for all users of the roadway, including but not limited to pedestrians, bicyclists, personal conveyance and micromobility users, public transportation users, children, older individuals, individuals with disabilities, motorists, and freight vehicles. In general, this design model includes careful consideration of measures to set and design for appropriate speeds; separation of various users in time and space; improvement of connectivity and access for pedestrians, bicyclists, and transit riders, including for people with disabilities; and addressing safety issues through implementation of safety countermeasures.

Congestion Management Process means a systematic approach required in transportation management areas (TMAs) that provides for effective management and operation, based on a cooperatively developed and implemented metropolitan-wide strategy, of new and existing transportation facilities eligible for funding under titles 23 and 49, U.S.C., through the use of travel demand reduction and operational management strategies. (23 CFR 450.104)

Financial Plan means a long-term plan, prepared as part of the TAMP, spanning 10 years or longer, presenting a State DOT's estimates of projected available financial resources and predicted expenditures in major asset categories that can be used to achieve State DOT targets for asset condition during the plan period. The Financial Plan also highlights how resources are expected to be allocated based on asset strategies, needs, shortfalls, and agency policies. (complete definition is in 23 CFR 515.5)

Full Performance Period Progress Report means the TPM report referenced in 23 CFR 490.107(b)(3) in which State DOTs report by October 1st of the first year following the reference performance period, including a State DOT's discussion of its progress toward achieving the 4-year targets and the effectiveness of investment strategies in the State DOT's TAMP.

Good, Fair, and Poor, when capitalized in this document, mean the conditions defined in 23 CFR 490.313 and 490.409 relating to assessing conditions for bridges and pavements on the National Highway System (NHS) in connection with TPM.

Highway Safety Improvement Program (HSIP) is a core Federal-aid program with a purpose to achieve a significant reduction in traffic fatalities and serious injuries on all public roads. The specific provisions pertaining to the HSIP can be found in 23 U.S.C. 148. These requirements include the development of Strategic Highway Safety Plans (SHSPs), in consultation with other key State and local highway safety stakeholders, as well as a number of reporting requirements.[1]

Investment Strategy Discussion means the discussion in the TPM Mid and Full Performance Period Progress Reports on the effectiveness of the investment strategies developed and documented in a TAMP under 23 U.S.C. 119(e) and 23 CFR 515.9 and referenced in 23 CFR 490.107(b)(1)(ii)(C).

Life-cycle Planning (LCP) means a TAMP process to estimate the cost of managing an asset class, or asset sub-group over its whole life with consideration for minimizing cost while preserving or improving the condition. (23 CFR 515.5)

Long-Range Statewide Transportation Plan (LRSTP) means the official, statewide, multimodal, transportation plan covering a period of no less than 20 years developed through the federally required statewide transportation planning process. (23 U.S.C. 135 and 23 CFR 450.104)

Long-Range Statewide Transportation Plan System Performance Report means the element of the LRSTP that evaluates the condition and performance of the transportation system with respect to the performance targets described in 23 CFR 450.206(c) including progress achieved by the metropolitan planning organization(s) (MPO) in meeting the performance targets in comparison with system performance recorded in previous reports. (23 CFR 450.216(f)(2))

Management System means a systematic process, designed to assist decision makers in selecting cost effective strategies/actions to improve the efficiency or safety of, and protect the investment in the nation's infrastructure. A management system may include procedures for functions such as identification of performance measures; data collection and analysis; determination of needs; evaluation and selection of appropriate strategies/actions to address the needs; and evaluation of the effectiveness of the implemented strategies/actions. (*see, e.g.*, 23 CFR 450.104 and 23 CFR 515.17)

Metropolitan Transportation Plan (MTP) means the federally required official multimodal transportation plan addressing no less than a 20-year planning horizon that the MPO develops, adopts, and updates through the metropolitan transportation planning process. (23 U.S.C. 134(i) and 23 CFR 450.104)

Metropolitan Transportation Plan System Performance Report means the element of the MTP that evaluates the condition and performance of the transportation system with respect to the performance targets described in 23 CFR 450.306(d), including progress achieved by the MPO in meeting the performance targets in comparison with system performance recorded in previous reports, including baseline data. (23 CFR 450.324 (f)(4))

Mid Performance Period Progress Report means the TPM report referenced in 23 CFR 490.107(b)(2) in which State DOTs report by October 1st of the third year in a performance period.

The report includes a discussion of their progress toward achieving 2-year targets and the effectiveness of the investment strategies in the TAMP.

National Freight Strategic Plan (NFSP) was announced on Sept. 3, 2020 and defines the U.S. Department of Transportation's vision and goals for the national multimodal freight system, assesses the conditions and performance of the freight system and barriers to freight system performance, and defines strategies to achieve its vision and goals.[2] (*see* Fixing America's Surface Transportation Act, section 8001, Public Law 114-94 (2015))

Performance-Based Planning and Programming (PBPP), as required under 23 U.S.C. 134 and 135, involves integrating performance management concepts into the existing federally required transportation planning and programming processes. PBPP involves using data to support long-range and short-range investment decision-making.
https://www.fhwa.dot.gov/planning/performance_based_planning/

Performance Gap means, for the purposes of a TAMP, the gaps between the current asset condition and State DOT targets for asset condition, and the gaps in system performance effectiveness that are best addressed by improving the physical assets. (23 CFR 515.5)

Performance Period means, for the purposes of TPM, a determined time period during which condition/performance is measured and evaluated to: assess condition/performance with respect to baseline condition/performance; and track progress toward the achievement of the targets that represent the intended condition/performance level at the midpoint and at the end of that time period. (23 CFR 490.101). The time period for a Performance Period for the bridge and pavement national measures, is 4 calendar years, and the first Performance Period started on January 1, 2018, and ends on December 31, 2021. (23 CFR 490.105(e)(4) and 490.107(b)(1))

Performance of the NHS, for purposes of a TAMP, refers to the effectiveness of the NHS in providing for the safe and efficient movement of people and goods where that performance can be affected by physical assets. This term does not include the performance measures established for performance of the Interstate System and performance of the NHS (excluding the Interstate System) under 23 U.S.C. 150(c)(3)(ii)(A)(IV)–(V). (23 CFR 515.5)

Project Selection means the procedures followed by MPOs, States, and public transportation operators to advance projects from the first 4 years of an approved TIP or STIP to implementation, in accordance with agreed upon transportation planning procedures. (23 CFR 450.104)

Public Transportation Agency Safety Plan (PTASP) refers to the plan referenced in 49 U.S.C. 5329(d) that includes, among other elements, methods for identifying and evaluating safety risks throughout all elements of the public transportation system.[3] (49 U.S.C. 5302(15))

Risk Management, for purposes of a TAMP, means the processes and framework for managing potential risks, including identifying, analyzing, evaluating, and addressing the risks to assets and system performance. (23 CFR 515.5)

Scenario Planning means a transportation planning process that evaluates the effects of alternative policies, plans and/or programs on the future of a community or region. This activity should provide information to decision makers as they develop the transportation plan. (23 CFR 450.104)

State Biennial Performance Report refers to all three State DOT TPM reports collectively required in 23 CFR 490.107(b). The three reports are Baseline Performance Period Report, Mid Performance Period Progress Report, and Full Performance Period Progress Report.

State Freight Plan means the plan developed by States under 49 U.S.C. 70202 that includes 10 required elements, including: identification of freight trends and needs; policies strategies, and performance measures; critical freight corridors; improvements that may be required to roadways traveled by heavy vehicles; facilities with freight mobility issues, such as bottlenecks; a freight investment plan; and consultation with a State freight advisory committee.

State Strategic Highway Safety Plan (SHSP) means a comprehensive, multiyear, data-driven plan developed by a State department of transportation (DOT) in accordance with 23 U.S.C. 148. (23 CFR 924.3)

Statewide Transportation Improvement Program (STIP) means a statewide prioritized listing/program of transportation projects, as required under 23 U.S.C. 135, covering a period of 4 years that is consistent with the long-range statewide transportation plan, metropolitan transportation plans, and TIPs, and required for projects to be eligible for funding under title 23 U.S.C. and title 49 U.S.C. Chapter 53. (23 CFR 450.104)

STIP Performance Discussion used in this document means a federally required discussion in the STIP of the anticipated effect of the STIP toward achieving the performance targets identified by the State in the statewide transportation plan or other State performance-based plan(s), linking investment priorities to those performance targets. (23 CFR 450.218(q))

System Performance Report is the section of the LRSTP and MTP that evaluates the condition and performance of the transportation system with respect to the performance targets described in 23 CFR 450.206(c) and 450.306(d), including progress achieved by the MPO(s) in meeting the performance targets in comparison with system performance recorded in previous reports. (23 CFR 450.216(f)(2) and 450.324(f)(4))

Target means, for purposes of TPM, transportation asset management under 23 U.S.C. 119(e), and transportation planning under 23 U.S.C. 134–135, a quantifiable level of performance or condition, expressed as a value for the measure, to be achieved within a time period required by the Federal Highway Administration (FHWA). (*see* 23 CFR 490.101 for definitions of "measure" and "target")

Transit Asset Management Plan means a plan required under 49 U.S.C. 5325 that includes an inventory of transit capital assets, a condition assessment of inventoried assets, a decision support tool, and a prioritization of investments. (49 CFR 625.25(b))

Transportation Asset Management Plan (TAMP) means the risk-based asset management plan defined in 23 CFR 515.5 and required under 23 U.S.C. 119(e) and 23 CFR Part 515. The TAMP is intended to carry out asset management as defined in 23 U.S.C. 101(a)(2) for NHS pavements and bridges. The TAMP describes how the State DOT will make risk-based decisions relating to managing the physical assets in the TAMP, using information from long-term assessments of those assets. The TAMP lays out a set of investment strategies to address asset condition and system performance gaps. This document describes how the highway network system will be managed to achieve State DOT targets for asset condition and system performance effectiveness while managing the risks, in a financially responsible manner, at a minimum practicable cost over the life cycle of its assets.

Transportation Improvement Program (TIP) means a prioritized listing/program of transportation projects required under 23 U.S.C. 134 and covering a period of 4 years that is developed and formally adopted by a metropolitan planning organization (MPO) as part of the metropolitan transportation planning process, consistent with the metropolitan transportation plan, and required for projects to be eligible for funding under title 23, U.S.C. and chapter 53 of title 49, U.S.C. (23 CFR 450.104)

TIP Performance Discussion, used in this document, means a federally required discussion in the TIP of the anticipated effect of the TIP toward achieving the performance targets identified in the metropolitan transportation plan, linking investment priorities to those performance targets per 23 CFR. 450.326(d).

Transportation Performance Management (TPM) is a strategic approach that uses system information to make investment and policy decisions to achieve national performance goals pursuant to 23 U.S.C. 150.[4] (23 U.S.C. 150)

Update means, for purposes of transportation planning under 23 U.S.C. 134–135, making current an LRSTP, MPT, TIP, or STIP through a comprehensive review. Updates require public review and comment, a 20-year horizon for MTPs and LRSTPs, a 4-year program period for TIPs and STIPs, demonstration of fiscal constraint (except for LRSTPs), and a conformity determination (MTPs and TIPs in nonattainment and maintenance areas). (23 CFR 450.104)

Transportation Systems Management and Operations (TSMO) means, for purposes of title 23, U.S.C., integrated strategies to optimize the performance of existing infrastructure through the implementation of multimodal and intermodal, cross-jurisdictional systems, services, and projects designed to preserve capacity and improve security, safety, and reliability of the transportation system. (23 U.S.C. 101(a)(30))

Work Type, for purposes of a TAMP, means initial construction, maintenance, preservation, rehabilitation, and reconstruction. (23 CFR 515.5)

Introduction and Background

The Moving Ahead for Progress in the 21st Century Act (MAP-21), signed by President Barack Obama on July 6, 2012, as Public Law 112-141, included a policy declaration in 23 U.S.C 150(a) that "performance management will transform the Federal-aid highway program and provide a means to the most efficient investment of Federal transportation funds by refocusing on national transportation goals…" [5]

The national goals in U.S.C. 150(b) are broad and encompassing. They include safety, infrastructure condition, congestion reduction, system reliability, freight movement and economic vitality, environmental sustainability, and reduced project delivery delays.

Other provisions of Federal law and regulations established or amended a series of plans and programs to implement the performance-based Federal-aid Highway Program and to make progress toward the national goals. A list of those plans and programs is included on page 3.

After enactment of MAP-21, FHWA undertook three separate but related and complementary initiatives to link the performance-based programs. The three initiatives were focused on transportation asset management (TAM), transportation performance management (TPM), and performance-based planning and programming (PBPP).

This document describes the relationship between TAM, TPM, and PBPP and how they interface and influence one another. It also describes how State departments of transportation (DOTs) and metropolitan planning organizations (MPOs) can approach the three not as separate efforts, but as related, complementary efforts. This document suggests how State DOTs and MPOs can use performance-based plans such as the long-range statewide transportation plan (LRSTP) or the metropolitan transportation plan (MTP) to integrate into the planning process the goals, objectives, performance measures, investment strategies, and targets of TAM and TPM.[6] The linkage not only can help achieve the broad national goals but also helps achieve the State DOT and MPO targets under national performance measures established pursuant to 23 U.S.C. 150(c) for safety, bridges, pavements, congestion, travel time reliability, and freight.

What Are TAM, TPM, and PBPP?

FHWA defines asset management as a strategic and systematic process of operating, maintaining, and improving physical assets, with a focus on both engineering and economic analysis based upon quality information, to identify a structured sequence of maintenance, preservation, repair, rehabilitation, and replacement actions that will achieve and sustain a desired SOGR over the life cycle of the assets at minimum practicable cost.[7]

FHWA defines Transportation Performance Management as a strategic approach that uses system information to make investment and policy decisions to achieve national performance goals. [8]

In short, Transportation Performance Management:

- Is systematically applied, a regular ongoing process.
- Provides key information to help decision makers to understand the consequences of investment decisions across transportation assets or modes.
- Works to improve communications between decision makers, stakeholders, and the traveling public.

- Seeks to ensure that targets and measures are developed through cooperative working relationships based on data and objective information.

TAM leads to the risk-based transportation asset management plans (TAMP). Per 23 CFR 515.9(h), a State DOT shall integrate its asset management plan into its transportation planning processes that lead to the STIP to support its efforts to achieve the goals cited in 23 CFR 515.9(f) of:

1. Achieving and sustaining a desired state of good repair (SOGR) over the life cycle of the assets.
2. Improving or preserving the condition of the assets and the performance of the NHS relating to physical assets.
3. Achieving the State DOT targets for asset condition and performance of the NHS in accordance with 23 U.S.C. 150(d).
4. Achieving the national goals identified in 23 U.S.C. 150(b).

Similar or related language regarding integrating asset management principles and techniques and the TAMP into the statewide or metropolitan planning processes occurs in 23 CFR 450.206(c)(4), 450.208(e), and 450.306(d)(4)(i).

Performance-based planning and programming applies performance management within the planning and programming processes.[9] PBPP incorporates the pursuit of performance outcomes into the transportation planning and programming process.

FHWA has described the linkage between asset management and performance management. [10] Transportation performance management is an *approach* to managing transportation system performance outcomes. Asset management is the *application of this approach* to manage the condition of the infrastructure assets that are needed to provide for mobility and safety on the Nation's transportation system. In short, asset management is the engine that drives infrastructure performance. The application of the TPM approach ensures that investments are performance-driven and outcome based.

Those processes and investment strategies are documented in management plans the agencies develop for the various program areas. All management plans are then used in the performance-based planning and programming process to make investment trade-off decisions.

The Audience for this Document

This document was developed for the leaders and staff at State DOTs, MPOs, and particularly program leads for planning, asset management, safety, congestion, freight, and performance.

Document Summary: TAM, TPM, and PBPP Complement One Another

The main message of this document is that TAM, TPM, and PBPP complement one another to help State DOTs achieve their targets and progress toward achievement of the national goals. State DOTs and MPOs shall integrate the products of programs such as asset management, safety, congestion, and freight.[11] The efforts of each can help to inform the efforts of all. TAM, TPM, and PBPP can continuously interface so that each of those performance programs influences the others. All the performance programs can contribute toward the State performance efforts and the advancement toward the national goals.

For example:

- The decision-making process for asset investments can incorporate safety considerations such as improving pavement friction and reducing rutting.
- Investments for freight mobility can be made while considering pavement and bridge rehabilitation needs on major freight corridors.
- Decisions for the timing of and design for capacity-expansion projects should consider the long-term bridge and pavement life-cycle plans for those expanded highway sections.
- Plans to address the long-term impacts of extreme weather on at-risk bridges and pavements can be coordinated with the life-cycle plans for those pavements and bridges that call for periodic reconstruction or replacement.
- A State DOT or MPO can consider how urban pavement and bridge reconstruction projects can be coordinated with objectives to improve safety for all road users and provide Complete Streets or make streets and sidewalks livable and accessible for people with disabilities.

Performance-based plans such as the LRSTP, the MTP, and the TAMP as the main product of TAM, provide opportunities to reassess long-term strategies for achieving performance targets and the seven national goals. At those reassessment points, agency staff and leaders can review performance in all the areas including bridge and pavement conditions, safety, freight reliability, congestion, travel time reliability, and emission reductions. Agency staff and leaders can take a long-term, comprehensive look at how each plan or program update contributes to the overall performance of the transportation system.

Performance-Based Plans and Programs

- Strategic Highway Safety Plan (SHSP) as described in 23 U.S.C. 148(a)(11)
- Highway Safety Improvement Program (HSIP) as defined in 23 U.S.C 148(a)(3)
- Risk-Based Transportation Asset Management Plans (TAMPs) described in 23 U.S.C. 119(e)
- State Freight Plan described in 49 U.S.C. 70202
- The Congestion Mitigation and Air Quality Improvement Program Performance Plan in 23 U.S.C. 149(l)
- Transit Asset Management Plan as discussed in 49 U.S.C. 5326
- Public Transportation Agency Safety Plan in 49 U.S.C. 5329(d)
- The National Highway Performance Program from 23 U.S.C. 119.

How the TAMP Can Complement Other Performance Plans and Processes

Principles of TAM are applied through development and implementation of the TAMP. The FHWA provides guidance on the scope and content of the TAMP required under 23 U.S.C. 119(e) at https://www.fhwa.dot.gov/asset/guidance/faqs.cfm.

A risk-based TAMP should include investment strategies that lead to a program of projects that would make progress toward achievement of the State DOT targets for asset condition and performance of the NHS in accordance with 23 U.S.C. 150(d) and support progress toward the achievement of the national goals identified in 23 U.S.C. 150(b) and 23 U.S.C. 119(e)(2).[12] State DOTs must address NHS pavements and bridges, but are encouraged to include all infrastructure assets within the highway right-of-way in their TAMP, per 23 CFR 515.9(b)-(c).

Each section of a TAMP provides opportunities for a State DOT's asset management efforts to support progress toward performance targets of the NHS and achievement of the national goals. Each TAMP section will be mentioned and how each could support other performance areas will be briefly summarized.

The TAMP must include per 23 CFR 515.9(b) and (d):

- A summary listing of the pavement and bridge assets on the NHS in the State regardless of ownership, including a description of the condition of those assets.
- Asset management objectives.
- Asset management measures and State DOT targets for asset condition.
- Performance gap identification.
- Life-cycle planning.
- Risk management analysis.
- Financial plan.
- Investment strategies.

The following briefly describes some ways in which each TAMP section could complement other performance areas or demonstrate links to other performance areas.

The summary listing of bridges and pavements and their condition could include descriptions of the assets' condition that may be relevant to other performance areas. For example, the summary description of assets and their condition could note the number, extent, and condition of:

- The structures still in need of seismic retrofitting to complement agency resilience goals.
- The number of lane miles or structures at risk from extreme weather or storm surge.
- The number of load-limited structures that impede freight mobility.

The asset management objectives could state specifically that the State DOT's bridge and pavement programs will seek opportunities to coordinate and complement other performance programs.

State DOTs could enhance their own (non-Federal) performance measures and targets to complement other objectives such as adopting new targets to:

- Reduce lane miles with low friction values or serious rutting to enhance safety.
- Ensure that, as appropriate, pavement treatments include safety features such as longitudinal rumble strips or the Safety Edge shoulder treatment.

- Reduce the number of scour-critical structures.
- Replace or rehabilitate the number of load-limited structures to enhance freight movement.

Building from the enhanced State measures and targets, agencies could describe not only the gaps between NHS bridge and pavement conditions and federally required targets but also how condition gaps contribute to other performance gaps such as:

- Bridges lacking sufficient width to handle peak-hour traffic volumes, and which reduce travel time reliability.
- Structures on evacuation routes that may be scour critical, seismically vulnerable, or in Poor condition that could affect their resilience
- Pavements subject to rapid deterioration because of periodic flooding.
- Multi-modal bridges lacking safe pedestrian and bicycle facilities.

The life-cycle planning section of a TAMP could discuss linkages between TAMP strategies for bridges and pavement and how those strategies influence:

- Bridge and pavement investment strategies included in the LRSTP.
- Bridge and pavement investments to enhance resilience such as reducing threats caused by scour or roadway inundation.
- When to widen NHS sections to improve travel time reliability, reduce congestion, and mitigate crashes which could lead to the reconstruction of bridges and pavements before the end of their expected life cycle.
- How to improve pedestrian safety features, such as road diets and pedestrian refuge islands, on urban and suburban routes that increase the life-cycle costs of pavements, but which advance safety objectives.
- How to provide pedestrian and bicycle accommodation on bridges.[13]
- How to increase sidewalks and walkways to improve the safety of pedestrians.
- The bundling of preservation treatments with upgrades to signs, pavement markings, and barriers to reduce the life-cycle costs of all those assets.

The risk management analysis must lead to a mitigation plan addressing the top priority risks (23 CFR 515.7(c)(4)). Risks that have not been identified as top priority could still contribute to addressing performance gaps such as:

- How frequently flooded roadway sections create risks to resilience and safety during emergencies.
- Whether load-limited structures on evacuation routes pose risks to delivering over-sized loads to population centers after catastrophes.
- If increased storm or fire frequency creates risks to assets and whether hardening of those assets would cost effectively reduce those risks.

The TAMP financial plan and investment strategies present another opportunity to interface with and influence the performance-based LRSTP and MTP. Financial plans are optional for the LRSTP. The 10-year TAMP financial plan could provide an informative contribution to the financial discussion in the 20-year LRSTP. The TAMP financial plan and investment strategies could provide the first half of the 20-year LRSTP's investment strategies for maintaining the condition of pavements and bridges.

The TAMP financial plan also could interface with and influence the MPOs' 20-year, fiscally constrained MTPs. Large mobility and capacity projects in metropolitan regions often rely on State DOTs for all or part of their funding. The State DOT's TAMP financial plan can provide insights into the degree to which funding for capacity projects may be available after bridge and pavement investment needs are met. If the TAMP financial plan indicates that most of the State DOT's funding will be needed to meet asset condition targets, the MPO can factor that information into forecasts for its MTP financial plan. The amount of funding available to the DOT after SOGR investments are made could be a significant factor in the MPO's financial constraint analysis. Metropolitan capacity projects could be constrained if most of the State's resources are needed to meet bridge and pavement targets over the life of the MTP.

Various FHWA publications discuss components of the TAMP; some are listed as additional resources at the end of this document.

Plan and Program Updates Link TAM, TPM, and PBPP

This section describes the program and plan updates that can be decision points and opportunities for State DOT and MPO, TAM, TPM, and PBPP efforts to interface and influence one another. State DOT and MPO program managers can collaborate so that performance plans and programs are coordinated to advance toward the national goals. By "performance plans," this document refers to examples such as the LRSTP, the MTP, the TAMP, the State freight plan, the SHSP, the congestion management process, the CMAQ Performance Plan, the Transit Asset Management Plan, and the Public Transportation Agency Safety Plan. By "performance programs," this document refers to State DOTs' or MPOs' collection of projects and strategies for pavements, bridges, safety, congestion management, freight, Complete Streets, livability, or environmental sustainability. The term "program of projects" is used in this document to refer to the collection of projects in the STIP and TIPs for pavements, bridges, safety, congestion management, freight, Complete Streets, livability, or environmental sustainability.

The performance plans and their review and update processes can create an ongoing cycle of opportunities for TAM, TPM, and PBPP to interface and influence one another. There can be a continuous cycle of identifying objectives, setting targets, selecting strategies, allocating money, evaluating results, and reporting the outcome of those decisions to the public. State DOTs and MPOs can use each step in the cyclical process of setting targets and reviewing results to evaluate progress toward the national goals and State targets.

The TAMP Can Interface with Multiple Performance Areas

When TAMPs are updated, State DOTs and MPOs could consider not only how the TAMP can achieve bridge and pavement condition targets and the SOGR, but also how the TAMP's investment strategies can interface with other performance objectives. Later sections of this document, elaborate how the TAMP's bridge program could contribute to freight mobility by improving load-limited structures on major freight routes. TAMP pavement investment strategies could support safety by improving pavement friction, particularly on curves, intersections, and other higher-risk locations. The TAMP could contribute to the congestion management efforts by coordinating the widening/reconstruction of high-volume pavements and bridges with plans to alleviate congestion at those locations.

Under 23 CFR 450. 206 and 450.306, the State DOT and MPOs must integrate into the statewide and metropolitan planning processes the goals, objectives, and performance measures described in 23 CFR Part 490 (where applicable) and other State transportation plans and processes, including the TAMP. Per 23 CFR 515.9(f), the TAMP must discuss how its investment strategies collectively would make or support progress toward several objectives, including achievement of State targets for pavements and bridges established pursuant to 23 U.S.C. 150(d).

The coordination between the TAMP and the other performance plans and programs can occur through review and consultation or by using information from the TAMP to inform target setting. The staff who develop the TAMP can review the other performance plans and programs including the SHSP, the HSIP, the freight plan, LRSTP, MTPs, STIPs and TIPs, and the congestion management plan or process. TAMP staff also could participate in the development of the other performance-based plans. Additionally, the TAMP program managers could review other State DOT and MPO objectives or policies such as those for resilience, Complete Streets, livability, environmental justice, or sustainability. Furthermore, the TAMP program managers could solicit collaboration with those plans and programs through strategies including possibly:

- Forming committees of stakeholders from the other program areas to provide input during the TAMP development on TAMP objectives, gap analysis, life-cycle plan, risk analysis, financial plan, and investment strategies.
- Circulating drafts of the TAMP updates to those stakeholders for review and comment.
- Incorporating into the TAMP broader objectives specifically stating that asset management investment strategies are intended to work together with the other performance areas.
- Coordinating with senior agency leaders to ensure the TAMP and all other performance plans and programs are aligned and complementary.

TAM can interface and influence other performance and planning areas more frequently than once every four years when the TAMP is updated. Each year, State DOTs will submit Annual Consistency Determination Documents to demonstrate implementation of their asset management plans as required by 23 CFR 515.13(b). The Annual Consistency Determination Document provides another opportunity for State DOTs to assess if they are implementing their investment strategies that support the State targets, system performance, and national goals. The Annual Consistency Determination Documents are to show that the State DOT has a compliant TAMP and is implementing it.

State DOTs should use the development of the Annual Consistency Determination Document to assess if their actual spending on the TAMP work types (maintenance, preservation, rehabilitation, reconstruction, and initial construction) is aligning with the TAMP investment strategies. If actual expenditures do not align with the TAMP investment strategies, State DOTs should consider:

- Assessing with bridge, pavement, and other program managers why projects are not being delivered and maintenance allocations expended to align with the TAMP investment strategies.
- Comparing the projects in the STIP and TIP, as well as State-funded projects and maintenance activities outside of the STIP/TIP, to determine if they align with the investment strategies.
- Determining if they should update their TAMP earlier than the 4-year cycle to better align the DOT's construction and maintenance programs with the TAMP investment strategies.

- Ensuring the Annual Consistency Determination Documents inform the next review of 2-year and 4-year TPM performance reports.

State DOTs can use the required TPM Mid Performance Period (23 CFR 490.107(b)(2)) and Full Performance Period Progress Reports (23 CFR 490.107(b)(3)) as additional opportunities to evaluate if their TAMP investment strategies are achieving their intended results. Intended results can include not only achieving 2-year and 4-year bridge and pavement targets, but also whether the TAMP investment strategies are supporting the national goals in 23 U.S.C. 150(b) for safety, infrastructure condition, congestion reduction, system reliability, freight movement and economic vitality, environmental sustainability, and reduced project delivery delays.

If progress toward achieving national goals is not being made the State DOT again could consider what adjustment it needs to make regarding:

- Ensuring the projects being delivered align with the TAMP investment strategies and the strategies of the other performance programs.
- If the investment strategies are achieving their intended effect.
- If the TAMP should be updated to re-align its investment strategies to better achieve 2-year and 4-year bridge and pavement targets, progressing toward the SOGR, and supporting the national goals.
- Determining if 4-year targets should be adjusted.

How TAM and TPM Interface with Planning and Programming

Further interface of TAMP, TPM, and PBPP occur in the LRSTP and MTP and in STIPs and TIPs, which derive from the statewide and metropolitan planning processes.[14]

The statewide transportation planning process and the metropolitan transportation planning process[15] will incorporate the goals, objectives, performance measures, and targets in other State transportation plans and transportation processes. Examples of such plans and processes include but are not limited to the:

- TAMP.
- Transit Asset Management Plan.
- SHSP.
- HSIP.
- Public Transportation Agency Safety Plan (PTASP).
- State freight plan.
- CMAQ Performance Plan, and/or the results of the Congestion Management Process in the transportation management areas (TMAs) per 23 CFR 450.322.
- Targets related to pavement and bridge conditions, safety, congestion, freight, travel time reliability, and emissions that State DOTs and MPOs establish pursuant to 23 CFR Part 490.
- Complete Streets Prioritization Plans
- Comprehensive Safety Action Plans

In carrying out the statewide transportation planning process for the NHS, States should apply asset management principles consistent with the TAMP for the NHS, the transit asset management plan, and the public transportation agency safety plan in establishing planning goals, defining STIP priorities, and assessing transportation investment decisions.[16] Additionally, the LRSTP should include capital, operations and management strategies, investments, procedures, and other

measures to ensure the preservation and most efficient use of the existing transportation system, among other considerations.[17]

The Role of the System Performance Reports in Interfacing with TAM

The LRSTP and MTP will further link all performance areas by including a System Performance Report that reviews performance in all performance areas.[18] This report evaluates the condition and performance of the transportation system based on the performance targets including progress compared to earlier reports.

State DOTs should consider incorporating into their LRSTP System Performance Report the long-term bridge and pavement forecasts from the TAMP as well as the TAMP investment strategies. The 20-year horizon of the LRSTP could complement and accommodate the long-term strategies and condition forecasts derived from bridge and pavement management systems. The long-term bridge and pavement scenarios generated by the management systems could help explain several issues important to a performance-based LRSTP including:

- How much annual investment is estimated to be needed for a 10-year or 20-year period to achieve condition targets for bridges and pavements and sustain them in a SOGR.
- Forecasted future conditions under current investment scenarios.
- Which portions of the network are most at risk of not achieving condition targets for bridges and pavements which may require additional, future investment over the life of the LRSTP, such as locally owned NHS assets.
- The impact programs such as bridge and pavement preservation have on achieving the long-term SOGR objectives.
- How much more investment would be needed to achieve the SOGR without continuous investment in preservation and maintenance.
- The most important risks and opportunities facing the bridge and pavement conditions.

How the STIP and TIP Can Illustrate the Interface with TAM, TPM, and PBPP

Further interfacing and influencing between the TAMP and the LRSTP occur in the STIP and in the metropolitan TIPs. Every four years at least, the planning process will generate updates of a STIP and TIPs listing the federally funded projects to be pursued (23 CFR 450.218(g); 23 CFR 450.326(e)). The STIP and TIPs will include a discussion of their anticipated effect toward achieving the performance targets identified in the LRSTP and MTP.[19] As part of that discussion, the STIP/TIP, to the maximum extent practicable, is to link its investment priorities to those various performance targets.[20]

State DOTs can consider how directly their STIP discussion draws links between the projects it includes and the investment strategies in the TAMP, HSIP, strategies deriving from the congestion management process in 23 CFR 450.322(d)(4), transit asset management plan, and other performance-based plans. Such a discussion could provide specific examples of how the objectives, strategies, and targets in the performance-based plans influence and interface with the program of projects States and MPOs develop.

The granularity in the TAMP financial plan and investment strategies provides potential investment levels by work type categories of initial construction, maintenance, preservation, rehabilitation, and reconstruction. Crosswalks between those work type categories and the projects or program funding levels in the STIP could demonstrate how the STIP is executing the TAMP investment

strategies. Such granularity also could expedite development of the Annual Consistency Determination Documents.

State DOTs and MPOs could consider whether more detailed reporting would be useful to demonstrate how the TAMP interfaces with and influences the STIP/TIP. More detail could be important because many maintenance, preservation, rehabilitation, and even some reconstruction projects are not listed individually in the STIP/TIP.

Projects not considered to be of appropriate scale for individual identification may be grouped together in the STIP and TIP by function, type, and where appropriate by geographic area using available classifications under 23 CFR 771.117(c) and (d) and 40 CFR Part 93. As a result, less detail about them is required to be reported in the STIP, in comparison to other types of projects. (23 CFR 450.218(j) and 450.326(h)). Examples of project groupings in the STIP/TIP could include asphalt overlays, pavement and bridge preventive maintenance, or bridge or pavement rehabilitation. These projects may be grouped as line items without specifying amounts for individual treatments or even treatment types. This grouping can mask projects and treatments that relate to TAMP investment strategies such as expenditures for pavement and bridge preservation or rehabilitation.

State DOTs and MPOs should consider whether enhanced reporting about the amounts and types of grouped projects could strengthen their STIP/TIP discussion of the anticipated effect toward achieving the performance targets. How the TAMP interfaces with and influences the programming process could be clarified with summary information of how the exempt projects carry out the TAMP investment strategies.

Interfacing Programs to Achieve Common Performance Objectives

This section discusses how achievement of some performance objectives and targets could be enhanced by interfacing between programs for bridges, pavements, safety (including Complete Streets), freight, and congestion, as well as socially focused programs such as livable communities. The interface of these performance-based programs occurs frequently on high-volume routes on the NHS. As discussed in greater detail below, many NHS roadway sections face issues of congestion, freight unreliability, marginal asset conditions, and elevated crash and fatality rates. Achieving performance objectives on these roadway sections could be enhanced if State DOTs and MPOs create interfaces between all the performance-based programs that affect these sections.

A summary of statistics illustrates the interfacing performance issues on the NHS as State DOTs and MPOs try to achieve the national goals for safety, reliability, and the SOGR. The NHS is only 8.7 percent of all lane miles nationally but carries 55 percent of all vehicle miles travelled (VMT.)[21] The relationship between lane miles and VMT on the Interstate System is even more disproportionate. Interstates are only 2.6 percent of the national lane miles[22] but carry 53.2 percent of combination truck vehicle miles traveled.[23] Trucks carry by weight 64 percent of the Nation's freight and 67 percent by value, with the majority of that moving on the NHS.[24]

Although fatality rates tend to be lower on the higher functional classes such as the Interstates and the NHS, the total number of crashes remains a problem. On the Interstates, the five-year rolling average of fatalities between 2016-2020 was 4,837.[25] That represents about 13 percent of all fatalities nationally over that period[26] occurring on the 2.6 percent of the road network comprising Interstates.

Almost 70 percent of the mileage of the National Highway System is not access-controlled[27] and these roads serve a wide variety of road users and purposes beyond rapid mobility. This includes most arterials in urban areas and many small town main streets, where the demands for throughput and local access creates a challenging safety environment. A majority of pedestrian fatalities take place on arterial roadways (61 percent).[28] These roadways are the focus of FHWA's Complete Streets initiative and a Complete Streets Design Model should be applied to them, as discussed in the safety section below.

The long-term trend as reported by FHWA is to expect growing urban congestion that will include increasing congestion on the NHS.[29] A review of 50 States' and Washington D.C.'s truck travel time reliability performance reports[30] indicates that of the 51 jurisdictions with measures reported, only 4 jurisdictions set 4-year targets for improving truck travel time reliability. The rest set targets for degrading truck travel time reliability compared to the baseline with a mean of State targets projecting a 13 percent worsening of reliability over 4 years. Although most States did not elaborate on why they set targets indicating that truck travel reliability may degrade, the frequency of the worsening targets appears to indicate uncertainty about maintaining current levels of reliability or a conservative approach to setting a target for a new measure. A review of actual performance showed that truck travel time reliability worsened by over 2 percent between 2017 and 2019 with 37 states showing a decrease in travel time reliability.[31]

These facts and figures about the Interstates and NHS as a whole underscore the centrality of those networks to national transportation performance. How the NHS performs in one performance area interfaces with and influences travel time reliability, freight movement, and safety performance. The many ways in which the NHS affects the Nation is reflected in the performance goals and the performance-based Federal program Congress established in 2012 in MAP-21.

The issues affecting the NHS and Interstates do not always fall neatly into categories. Congestion affects safety, freight volumes affect asset conditions, and asset conditions influence mobility, freight, and safety. The seven national goals may be enumerated separately but addressing them often needs to be done jointly. Their challenges highlight the importance of cross-cutting coordination and collaboration that occurs when TAM, TPM, and PBPP interface and influence one another.

The following section examines some ways in which those processes could interface and influence one another.

How Performance Objectives Interface on Major Corridors

As State DOTs and MPOs manage the impacts of growth in traffic, truck volumes, congestion, and freight movement over the next 20 years or more, they could see benefits from interfacing programs for congestion, travel time reliability, emissions reductions, safety, freight, and asset management. As congestion increases and freight volumes grow on aging pavements and bridges, solutions to any one performance area are likely to influence performance in another. For example, it is unlikely that a State DOT would improve a freight or congestion bottleneck without also improving bridges and pavements at the bottleneck. Conversely, plans to rebuild bridges or pavements at a bottleneck also could contribute to safety, congestion, or freight performance.

Figure 1 and Figure 2 illustrate how the growth in truck traffic will interface and influence performance in several areas. Figure 1 from the FHWA Freight Analysis Framework (FAF4) shows congestion on high-volume portions of the NHS in 2015 and Figure 2 shows the forecast for 2045.

FAF4 estimates that domestic U.S. truck tonnage will increase from 12.4 billion tons in 2020 to 16.4 billion tons by 2045, outpacing the growth of any other freight mode except air freight.[32] The FAF4 estimates the value of U.S. domestic product moved by truck will increase from $14.5 trillion in 2020 to $24 trillion in 2045.[33] These factors are subject to change because of shifts since 2015 such as returning oversees production to the U.S., a process called "reshoring", "onshoring", or "inshoring."[34] That trend could slow the rate of growth of global supply chains and increase domestic ones. That shift, however, does not reduce overall freight movement but changes its origins and destinations. Increases in domestic production could increase localized freight volumes. The National Freight Strategic Plan (NFSP) projected that because of future travel demand, peak-hour stop-and-go conditions will exist on over 27,000 miles of the NHS by 2045.[35]

The NFSP emphasized that addressing the Nation's highway freight needs will involve complex transportation planning issues, particularly in urbanized areas:

> Many of the Nation's most significant freight bottlenecks are at major highway interchanges in the country's largest metropolitan areas. Trucks moving through urban areas often encounter congestion and network inefficiencies due to peak period traffic volumes, special events, work zones, crashes, and other incidents. In addition, the physical and operational constraints (street width, roadway design, one-way streets, time-of-day restrictions, etc.) of the urban environment, can make it difficult or impossible for larger freight delivery vehicles to use certain routes or access certain neighborhoods. Truck drivers can also have difficulty finding available on-street and off-street loading and parking areas. Finally, urban residents may have concerns about emissions and noise associated with truck movements in their communities.[36]

The NFSP notes that between 2016 and 2020, States programmed more than $6.2 billion in National Highway Freight Program funding. That programming represented 1,200 distinct projects with one-third of the funds used to expand capacity on freight-heavy routes. Projects included truck-only lanes, high-occupancy vehicle (HOV) lanes, turning lanes, and general highway capacity.[37] With freight volumes predicted to grow, the performance-based plans increasingly will face challenges in how to balance freight mobility with other performance objectives.

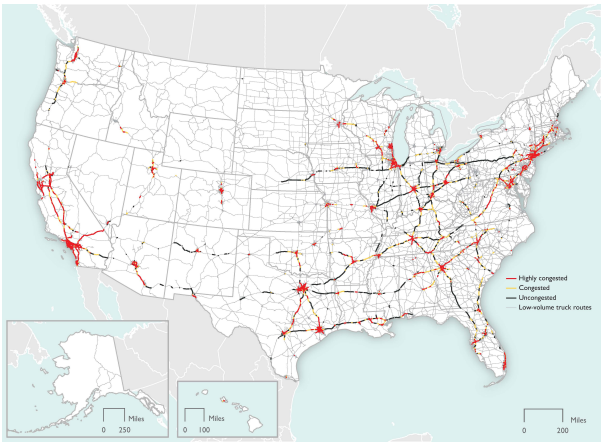

Figure 1 Peak-hour congestion on high-volume truck portions of the NHS in 2015. Source: FHWA FAF4

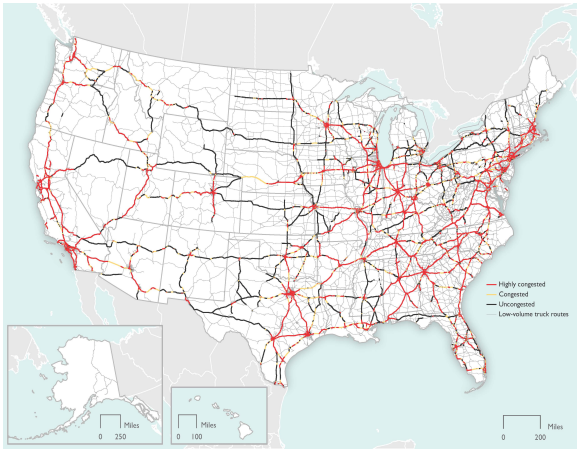

Figure 2 Peak-hour congestion on high-volume truck portions of the NHS in 2045. Source: FHWA FAF4

State DOTs and MPOs could consider how multiple program objectives can be addressed as they update their TAMPs, freight plans, congestion programs, and safety strategies to develop strategies for these NHS sections. Many of these bottlenecks are at system interchanges that include flyovers, multiple structures, ramps, and multiple lane miles of pavements. Sometimes the projects to address these major bottlenecks can be massive, such as Rhode Island's 6/10 project, which involves the repair of nine large structures, seven of which were in Poor condition.[38] That one project creates a measurable improvement in the statewide bridge inventory and improves a major congestion bottleneck.

The Role of Risk Management

The National Freight Strategic Plan notes the significant uncertainty that surrounds long-term projections of freight volumes, freight origins, and destinations. It notes that international factors such as energy prices, global trade patterns, new technologies, geopolitical events, and recessions all influence trade volumes and freight patterns.

These same uncertainties can influence other factors that State and MPO planners will evaluate as they consider long-term strategies to achieve performance for bridges, pavements, congestion, safety, emissions, and freight movement.

The asset management plan's risk analysis could provide a venue for evaluating these factors. Another venue could be the scenario planning analyses conducted within performance-based LRSTPs and MTPs.

Risk is defined in 23 CFR 515.5 as the positive or negative effects of uncertainty or variability upon agency objectives. Analyzing the risks around major planning assumptions can better prepare decision makers to respond to unexpected events and to adjust as they occur. DOTs and MPOs will be making 100-year decisions when they decide to replace a major bridge on a national freight route. Understanding the uncertainty around the bridge's or the corridor's future can lead to better defined problem statements and more informed decisions.

Another example is the I-90/94 and I-290 Circle Interchange (Jane Byrne Interchange) reconstruction in downtown Chicago, Ill. This is one of the top five bottlenecks in the country[39] that is having extensive reconstruction done. This has been under construction for a few years and is nearing completion.

Other improvements could be much smaller such as improving the curvature on one problematic ramp, or lengthening a merge area, or deploying operational strategies such as signage warning trucks of sharp curves. Examples such as these illustrate another interface between asset management strategies, congestion relief strategies, travel time reliability strategies, safety strategies, and freight mobility strategies.

The statute establishing the State Freight Plan requirement (49 U.S.C. 70202) includes several steps State DOTs must take that can interface with multiple programs. The State Freight Plan shall address a description of the improvements needed to improve roadways projected to be substantially deteriorated by travel of heavy vehicles such as those for mining, agriculture, energy cargo, or timber. [40] State freight plans also shall include an inventory of facilities with freight mobility issues such as bottlenecks and a description of strategies the State is employing to address those mobility issues. (49 U.S.C. 70202 (b)(7)). The plans also shall consider significant congestion or delay caused by freight movements and strategies to mitigate the congestion. (49 U.S.C. 70202(b)(8)).

FHWA Guidance on State Freight Plans and State Freight Advisory Committees notes that although freight plans are only required to have an 8-year horizon, (49 U.S.C. 70202(d)), State DOTs should consider extending that horizon to provide additional opportunities for linking asset management and freight-congestion strategies. [41] The eight-year horizon may not enable States to do more than list current problems and projects already in the pipeline. A horizon of 20 years allows increased linkage with asset management life-cycle strategies for pavements and bridges as well as with the LRSTP and MTP.

Over the next 20 years, State DOTs will face decisions regarding how to maintain the condition and performance of the thousands of bridges on the nation's freight network, many of which present issues of condition and performance. The National Highway Freight Network (NHFN) is a network of 52,020 centerline miles that has been designated according to 23 U.S.C. 167(c)(1). Nearly a third of the bridges on the NHFN were 51 years old or older as of 2016,[42] which means that within the next 20 years major rehabilitation or replacement will likely be considered. Many of those bridges are on sections already congested, which demonstrates the importance of coordinating decisions regarding life-cycle planning for the structures, how to accommodate freight demand, how to reduce crashes, and how to design the structures to complement mobility strategies.

The NFSP also notes the complexity of planning and implementing freight projects which involve coordination between State, regional, local, and often private-sector freight asset owners such as ports and railroads. The draft NFSP noted that greater cooperation between these groups will be an element of successful projects to improve freight movement performance and improve freight bottlenecks.

Among the issues facing State DOTs and MPOs as they balance decisions on how to manage bridge and pavement conditions with freight mobility and other performance objectives will be:

- Decisions on when to rehabilitate or reconstruct aging, high-volume bridges and pavements will probably be coordinated with decisions of whether to add capacity to those sections.
- Long-range solutions for low-lying roadways and bridges subject to sea level rise are likely to interface with objectives for resilience, freight mobility, congestion relief, and life-cycle planning.
- The long-term ability for high-volume bridges to transport "super loads" in the future may require coordinating bridge management decisions with freight-movement strategies.
- Travel-time reliability strategies that could involve improving bottlenecks and concurrently reconstructing the bridges, pavements, and ramps to achieve condition, performance, and safety objectives at those bottlenecks.

As State DOTs evaluate the best life-cycle solution to NHS bridges and pavements, they could consider not only targets established for the assets, but also the objectives for safety, congestion, freight mobility, emissions, and other planning priorities such as equity and livable communities. Multiple objectives have always been included in project-level planning. Forecasted travel volumes are used to determine the needed number of lanes while truck volumes influence decisions about pavement design, grades, and curvature. However, the objectives for freight, safety, mobility, and asset conditions could be of such magnitude that they influence program-wide funding levels, policies, and project prioritization. State DOTs and MPOs could consider the need for program-level strategies that target investments to achieve these multiple and interconnected performance goals.

Achieving Desired Long-Term NHS Bridge Conditions Involves Coordination with Other Programs

State DOTs' long-term, life-cycle management of bridges also could interface with, influence, and be influenced by other State and MPO objectives. A new bridge could remain in service for 75 to 100 years. During that long lifespan, the structure may influence traffic congestion, freight mobility, safety for a variety of road users, livability, or access for persons with disabilities.

Many factors come into play on how to maintain NHS bridges depending upon which routes the bridges are on, the role they play in adjacent neighborhoods, their freight volumes, and how they connect to local streets. Balanced with the following project-level considerations could also be program-performance considerations such as how the bridges contribute to asset condition, congestion, or freight-movement performance.

- If they are on a freeway without ramps into local neighborhoods, the primary considerations may be on freeway congestion, freight movement, emission reduction, and life-cycle cost.
- If the structures connect to streets used by public transportation, bicyclists, or pedestrians, the solutions may involve livable community and Complete Street considerations.
- If the structures or their approaches and ramps have elevated crash rates, solutions may emphasize crash-reduction measures.
- If the structures serve as community gateways, design esthetics and neighborhood compatibility may be important considerations.
- If they are historic, how to maintain them in good repair and retain their intrinsic character may be overriding factors.
- If they are threatened by sea level rise, long-term extreme weather, or seismic events, then resilience may be a major factor in their long-term management.

Large structures or aging bridge inventories present a challenge for State DOTs because of their high cost, and often because of their advanced age. Often these structures are on major routes without convenient detours. State DOTs could consider how the life-cycle plan for these structures interface with freight and congestion needs that will arise over the next 20 years.

- The Louisiana Department of Transportation and Development (LaDOTD) reported that 3.6 percent of its bridges by number comprise 57.7 percent of its NHS deck area.[43] How it addresses those large structures can have a disproportionate impact upon its bridge conditions, its financial plan, and the long-term ability of the structures to accommodate freight volumes.
- The Washington State Department of Transportation (WSDOT) has 266 bridges older than 80 years with an estimated replacement cost of $2.7 billion over 20 years.[44]
- The Massachusetts Department of Transportation (MassDOT) reported that 58.3 percent of its NHS bridges by area were built between 1940 and 1980.[45]
- The Idaho Transportation Department's (ITD) 10 largest bridges by deck area represent 12 percent of all its state highway system (SHS) bridge area. The average age of the ITD large structures was 31 years old. It is likely that, in the next 20 years, ITD will face decisions about how to sustain these bridges and ensure they continue to meet the State's mobility needs.

Decisions on how to manage these structures could be influenced by the asset management investment strategies, congestion plans, safety plans, freight plans, and MTPs. These considerations illustrate how asset management, transportation performance management, and performance-based planning and programming interface and influence one another. In these examples, it is unlikely that considering only one performance objective would result in the optimal overall solution. Contributing to the solutions could be the State DOT's bridge SOGR objectives, the MPO's congestion mitigation plan, the State's safety targets, and important social factors such as livable community goals.

Interfacing Asset Management Programs with Safety Programs

State DOTs can find numerous opportunities for the asset management program to interface with and be influenced by the SHSP and the HSIP objectives. Asset management can interface with highway safety performance by contributing to a SOGR for assets which help to reduce crashes.

Among the opportunities for asset management and safety objectives to intersect include:

- Coordinating pavement management strategies with strategies to reduce rutting and low pavement friction could be important to crash-reduction strategies. Rutting can contribute to hydroplaning while low-friction values can be particularly problematic on curves and at intersections.[46] Transportation agencies in the U.S. and abroad have produced examples of how coordination between the safety programs and the pavement programs drew increased attention to the role of friction in reducing crashes.[47] Such linkages could be particularly relevant with pavement preservation programs. Preservation program managers often respond quickly to apply surface treatments at the correct point in a pavement's life cycle. Friction treatments also sometimes require short-term actions as wet-weather crashes indicate friction deficiencies. Coordination between the programs could lead to multiple benefits.
- Pavement shoulder treatment strategies such as the SafetyEdge[SM] or wider shoulders also can be a crash-reduction counter measure that involves the pavement program. A way to link the two efforts would be at the program level to ensure that pavement managers have the funds for the incremental additional cost needed for shoulder repairs, and maintenance of drop offs.

FHWA encourages the incorporation of a Complete Streets design model in Resurfacing, Restoration, and Rehabilitation (RRR) procedures or design criteria that are applicable to urban and suburban nonfreeway arterials with posted speed limits less than 50 miles per hour (mph), or to rural arterials that serve as main streets in smaller communities. This model improves safety on roadways that must serve both mobility needs and local access, particularly when multiple modes are present, such as public transportation, pedestrians, and/or bicyclists. The application of the model is particularly important in neighborhoods where the population may be expected to rely on these forms of transportation.[48]

On these roadways, urban pavement and asset management programs can make a significant contribution to safety by incorporating infrastructure improvements for safety, including:

- Installing bicycle facilities during roadway resurfacing projects, as an efficient and cost-effective way for communities to create connected networks of bicycle facilities.
- Incorporating countermeasures to reduce speeds, conflict points, and provide safe access for people walking and bicycling, including raised medians, improved sidewalks and

walkways, road diets, flashing beacons, pedestrian refuge islands, crosswalk visibility enhancements, and leading pedestrian intervals at signalized intersections that give pedestrians time to walk before vehicles get a green signal to turn.[49,50]

- Managing signs, signals, pavement markings, barriers, and lighting to keep them in a SOGR so they continue to provide safety benefits. An increasing number of State DOTs are developing inventories for these items, predicting their life-cycle performance, and funding programs to keep them in good repair. Many of these same assets were implemented based on a systemic approach to safety which considers multiple locations with similar risk characteristics, selecting the preferred countermeasure(s) appropriate and affordable for widespread implementation.[51] Because countermeasures are intended to be widely implemented, it is necessary to identify low-cost solutions.[52] Case studies of Systemic Safety good practices include examples of DOTs improving lighting, centerline and pavement edge markings, the SafetyEdge[SM], rumble strips, tree removal, enhanced signage, and improvements to barriers.[53,54, 55] Once improved, asset management programs and strategies can keep these features in good repair and help ensure they do not become one-time investments.
- Coordinating with ADA Transition Plans and other efforts to enhance accessibility with improved curb ramps and other changes. Although project-level decisions are generally not made at the program level, program funding allocations may need to be added to pavement programs to accommodate the routine addition of sidewalks and ramps that support accessibility.

Linking Asset Programs to Resilience Strategies

Another area where State DOTs could consider the interface of long-term performance and asset management is with strategies to enhance the resilience of the transportation system. Decisions such as how to size a culvert are made at the project level based upon the site's hydrology. However, program-level action also may be important to ensure that program funds are available for the systematic, widespread improvement of culverts and other assets that may be affected by increased storm events, rising sea levels, or increased hurricane activity. Program-wide funding may be important to replace undersized culverts and other drainage structures.

Some examples of how long-term resilience objectives and asset management programs can interface include:

- Coordinating the life-cycle strategy for bridges and roadways with sea level rise impacts.
    - Bridges subject to wave action could have the superstructure and decks raised, which influences plans for keeping them in good repair over the long term.
    - Pavements in low-lying areas could be elevated and incorporate increased drainage structures to improve their long-term performance.

  Those types of improvements may increase costs that in turn would be reflected in the TAMP investment strategies.
- In non-coastal areas, increased storm frequency can influence maintenance and long-term repairs to catch basins and other drainage assets to reduce lane closures caused by short-term flooding.
- At-risk assets can be "flagged" in the asset inventories and tracked to assess their change over time because of environmental stresses.

- Vulnerable assets such as rockfall areas, unstable slopes, or sections subject to debris flows after wildfires can be treated with dedicated funding programs.

Focusing on Long-Term Strategies to Sustain Performance

State DOTs may increase awareness among legislators and other decision-makers of the need for steady, consistent investments by demonstrating the interface between asset management, short-term performance, and long-range planning and programming. State budgeting is often short-term with horizons of one or two years, while achieving long-term performance requires implementing strategies that can take decades. By linking long-term performance outcomes to short-term budgeting and programming decisions, State DOTs may strengthen the case for investing in steady, sustained preservation and maintenance strategies.

It is common for investments in preservation of bridges and pavements to show little impact on network-wide conditions over the short term. However, when bridge and pavement management systems illustrate the long-term benefits of preservation, the importance of steady, consistent, continuous investment becomes apparent. The bridge and pavement management systems that produce insightful analysis for the TAMP can also inform State DOTs, commissions, legislators, and MPO boards of the benefits of linking annual allocations to long-term outcomes.

The benefits of linking annual budget allocations to long-term performance objectives is not limited to asset management objectives. The Arizona Strategic Highway Safety Plan captured this concept by noting that countermeasures may not show a measurable impact for several years.[56] However, measured over years, these incremental reductions in crashes, injuries, and fatalities contribute to safer highways. This type of sentiment reflects the balancing of short-term performance and long-term objectives which occurs at the interface of asset management, transportation performance management, and performance-based planning and programming.

The TAMP's life cycle plan and investment strategies can inform the State DOT's annual budget allocations, program allocations to its Districts, and to its STIP. Life-cycle plans usually rely on steady application of preservation, the timely application of maintenance, and the periodic application of rehabilitation, and reconstruction strategies. Life-cycle plans estimate the amounts needed for these work types years in advance. Those life-cycle plans and their accompanying financial plans and investment strategies should influence annual programming strategies. Each year's program should represent an annual increment of the long-term SOGR strategy. The result of that influence should be predictable, sustained levels of investments that contribute to the SOGR.

Just as travel demand models play significant roles in the metropolitan and statewide processes for capacity planning, the bridge and pavement management systems should play an increasingly important role in long-range planning. Bridge and pavement management systems can produce long-term investment strategies incorporating funding levels for maintenance, preservation, rehabilitation, and reconstruction for 20 years or more.

Bridge and pavement management systems also can contribute significantly to transportation performance management, scenario planning, and performance-based planning. They can create multiple scenarios based upon different funding levels, different treatment strategies, and different traffic volume assumptions. These scenarios allow planners to consider which strategies are most effective at achieving targets and at informing the long-range planning process. Such information enhances the LRSTP and MTP.

Using Performance Reports as Communication Tools

While the linkage of TAM, TPM, and PBPP can strengthen internal State DOT and MPO processes, State DOTs could also consider how their linkage can inform important external stakeholders. State DOTs can use the Annual Consistency Determination Document [57] and the Mid Performance Period Progress Reports and Full Performance Period Progress Reports [58] as opportunities to inform commissions, legislative committees, and agency leaders of progress made toward the agency's objectives and targets.

For MPOs, the System Performance Report provides a means to inform the MPO policy board and the member communities of progress toward implementing the long-term strategies for infrastructure condition, safety, freight, and congestion. MPOs often operate under formal protocols in which community leaders comprise the policy board. Local technical staff such as city service directors or assistant county engineers usually sit on the MPO technical committees. Public involvement is required.[59] Also, the MPO boards and technical committees meet in public sessions that are often attended by the media and public interest groups. Development and discussion of the System Performance Report provides an opportunity to share the performance update with a wide audience of regional decision makers.

Approvals of the TIP and its description of its anticipated effect toward achieving the performance targets provides another opportunity to share with stakeholders the progress made toward meeting long-term performance objectives.

The engagement of MPOs with safety, congestion, and mobile source emissions is not new. However, the focus in these areas may become more precise and outcomes better defined because of the precision inherent in the performance targets. The TIP discussion of progress toward achieving targets should prompt the MPO boards to periodically evaluate how their programs directly relate to the national goals, performance targets, and the long-term SOGR. Then, as they update their long-range plans every four or five years, those plans will include the System Performance Report[60] that should summarize progress made to date.

Engagement Will Vary with MPO Size

With 408 MPOs nationally and 52 departments of transportation implementing performance-based programs, there will be substantial variation between how State DOTs and MPOs interact regarding TAM, TPM, and PBPP. DOTs engage in the planning process with metropolitan areas as small as 50,000 to as large as the Southern California Association of Governments (SCAG) that encompasses 191 cities, 18 million people, 38,000 square miles, manages 11,658 lane miles of the NHS and 13.8 million square feet of NHS bridge area.[61]

For many small planning organizations, the degree of performance management engagement with the State DOT could be relatively minimal. It could be limited to joint agreements on data collection, target setting, and STIP/TIP development. The larger MPOs may engage in joint decision making for major decisions on how to maintain the performance of the NHS and to achieve the national transportation goals.

Conclusion

TAM, TPM, and PBPP create a mutually reinforcing and continuous process of setting short-term targets and implementing long-term strategies that keep transportation departments and regional

planning agencies focused on steady, continuous, long-term investments to support the seven national goals.

State and regional decision makers should regularly assess their progress toward delivering their investment strategies, achieving their objectives and targets, and progressing toward the national goals. These assessments should occur through:

- Asset Management Annual Consistency Determination Documents.
- TPM Mid Performance Period Progress Reports.
- TPM Full Performance Period Progress Reports.
- STIP/TIP performance discussions when the STIP/TIPs are updated.
- TAMP updates.
- System Performance Reports within the LRSTP and MTP.

Each action does not have to occur in isolation within individual program areas. Instead, State DOT and MPO staff could coordinate across program areas. They could ensure that the contribution that asset management can make to safety or freight performance is considered. They could evaluate how freight plans can complement plans to alleviate congestion or rebuild pavements and bridges on major freight routes. The pavement program could be informed by policies to provide Complete Streets and to build livable communities.

Cross-cutting discussions often occur in the planning phase of major projects. What State DOTs and MPOs could consider is how cross-cutting cooperation can improve planning-level investment strategies. For example:

- If agencies want the urban pavement programs to complement Complete Streets, then the pavement program investment strategy should have the money, policy, and planning resources for the pavement program to support the goal of providing for the safety of all road users.
- If the bridge program is to consider the needs for bridges to be wide enough to accommodate the lanes called for in the congestion program, the cost of and timing for the expanded bridges should be factored into the bridge life-cycle plan.
- If drainage structures are to become more resilient to withstand extreme weather, those costs should be reflected in the 10-year bridge, culvert, and drainage structures investment strategies.
- If program areas are to cooperate, a structure for cooperation is key. A cooperative planning and programming process could use opportunities such as the TAMP update or the System Performance Report as intersections to ensure that programs interface and influence one another.
- At each update, performance could be considered not only in relation to one objective, but in relation to all performance objectives. Performance in one area is likely to affect performance in another. Over time, the linkages between performance areas should grow.

State DOTs and MPOs should consider how achieving complex performance objectives cuts across multiple jurisdictions. They should use the LRSTP and MTP and TAMPs as coordination points to bring stakeholders together to evaluate performance in all programs. Many of the issues that underlie asset conditions, or freight congestion, or crashes involve multiple jurisdictions and agencies. Pedestrian crashes on State routes in suburban areas are just one example of important performance issues that cut across agencies. Alleviating urban freight bottlenecks can involve cities,

MPOs, DOTs, and private carriers such as railroads. DOTs may struggle to achieve NHS bridge and pavement performance targets if the locally managed NHS assets are consistently in Poor condition.

Increasing coordination and collaboration should occur at the interface of asset management, safety, congestion, travel time reliability, mobile source emission reduction, and freight programs as asset conditions change and as the plans are updated in the years ahead. Short-term baseline data will indicate where condition and performance are today. The 2-year and 4-year targets will indicate the near-term direction. Then TAMPs, LRSTPs, and MTPs will extrapolate the horizons of performance and conditions to illustrate coming trends. Collectively, TAM, TPM, and PBPP will provide trendlines of performance and conditions and serve as regular update points to evaluate progress toward national transportation goals.

Additional Resources

Statewide and Nonmetropolitan Transportation Planning; Metropolitan Transportation Planning, Federal Register/Vol.81, No. 103/Friday, May 27, 2016, 23 CFR Parts 450 and 771

Asset Management Plans and Periodic Evaluations of Facilities Repeatedly Requiring Repair and Reconstruction Due to Emergency Events, Federal Register/Vol. 81, No. 205/Monday, October 24, 2016/Rules and Regulations, 23 CFR Parts 515 and 667

Guidance on State Freight Plans and State Freight Advisory Committees, Federal Register/Vol. 81, No. 199/Friday, October 14, 2016/Notices

Integrating Asset Management and Planning, an FHWA Transportation Asset Management Expert Task Group (TAMETG) white paper at https://www.fhwa.dot.gov/asset/etg/pubs/whitepaper3.pdf

Integrating Asset Management into the Planning Process, - A Case Study, an FHWA Transportation Asset Management Expert Task Group (TAMETG) white paper at https://www.fhwa.dot.gov/asset/etg/pubs/integrating_casestudy.pdf

The many resources on the FHWA Asset Management website at https://www.fhwa.dot.gov/asset/guidance.cfm

The many resources on the FHWA Transportation Performance Management website at https://www.fhwa.dot.gov/tpm/

The many resources on the FHWA Performance-Based Planning and Programming websites at https://www.fhwa.dot.gov/planning/performance_based_planning/ and https://ops.fhwa.dot.gov/plan4ops/performance_based.htm

The growing resources of the FHWA Complete Streets Initiative: https://highways.dot.gov/complete-streets

[1] FHWA About Highway Safety Improvement Program (HSIP) accessed at https://safety.fhwa.dot.gov/hsip/about.cfm.

[2] U.S. Department of Transportation National Freight Strategic Plan, accessed at https://www.transportation.gov/sites/dot.gov/files/2020-09/NFSP_fullplan_508_0.pdf.

[3] Federal Transit Administration, Scenario Planning, accessed at https://www.transit.dot.gov/regulations-and-guidance/transportation-planning/scenario-planning.

[4] Federal Highway Administration Transportation Performance Management website accessed at https://www.fhwa.dot.gov/tpm/about/tpm.cfm.

[5] Federal Highway Administration, Moving Ahead for Progress in the 21st Century Act (MAP-21) accessed August 11, 2021, at https://www.transportation.gov/map21.

[6] 23 CFR 450.206(c)(4) and 23 CFR 450.306(d)(2)(iii)(4)

[7] 23 CFR 515.5

[8] FHWA What is TPM? Accessed March 13, 2019, at https://www.fhwa.dot.gov/tpm/about/tpm.cfm.

[9] FHWA's Performance Based Planning and Programming Guidebook, Sept. 2013, p iii.

[10] Federal Highway Administration, How TPM and Asset Management Work Together, accessed August 10, 2021, at https://www.fhwa.dot.gov/tpm/resources/working.cfm.

[11] 23 CFR 515.9(h), 23 CFR 450.206(c)(4) and 450.306(d)(4).

[12] 23 CFR 515.7(e), 515.9(d)(8) and (f)

[13] 23 U.S.C. 217(e)

[14] 23 CFR 450.206(c), 23 CFR 450.306(d),23 CFR 450.218(q), 23 CFR 450.326(d), 23 CFR 450.216(f) and 450.324(f)

[15] 23 CFR 450.206(c)(4) and 450.306(d)(4)

[16] 23 CFR 450.208 (e)

[17] 23 CFR 450.216 (b)

[18] 23 CFR 450.216(f), 23 CFR 450.324(f)

[19] 23 CFR 450.218(q) and 23 CFR 450.324(f)(4)

[20] 23 CFR 450.218(q) and 450.326(d)

[21] Percentage derived from reviewing FHWA Highway Statistics 2018 Tables HM-60 Estimated Lane-Miles by Functional System, Table HM-43 National Highway System Lane-Miles by functional system, Table VM-2 Vehicle-miles of travel, by functional system, and Table HM-44 Vehicle miles of travel by functional system.

[22] Derived from FHWA Highway Statistics 2018 Table HM-48 Federal-Aid Highway Lane – Length – 2018.

[23] FHWA, Freight Facts and Figures, Annual vehicle miles traveled by highway category and vehicle type, https://datahub.transportation.gov/stories/s/Freight-Transportation-System-Extent-Use/r3vy-npqd.

[24] Values generated by the Freight Analysis Framework 4 (FAF4) Data Tabulation Tool accessed at https://ops.fhwa.dot.gov/freight/freight_analysis/faf/faf4/netwkdbflow/index.htm.

[25] FHWA Roadway Safety Professional Capacity Building Roadway Safety Dashboard National Fatalities between 2016-2020 for the Interstates, accessed at https://rspcb.safety.fhwa.dot.gov/Dashboard/Default.aspx.

[26] FHWA Roadway Safety Professional Capacity Building Roadway Safety Dashboard National Fatalities between 2014-2018 for all roads, accessed at https://rspcb.safety.fhwa.dot.gov/Dashboard/Default.aspx.

[27] FHWA Highway Statistics 2019 Table HM-18, accessed at https://www.fhwa.dot.gov/policyinformation/statistics/2019/hm18.cfm.

[28] FHWA Roadway Safety Professional Capacity Building Program Roadway Safety Data Dashboard National Pedestrian Fatalities in 2020 for arterials roads, accessed at https://rspcb.safety.fhwa.dot.gov/Dashboard/Default.aspx.

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[32] FAF4 Data Tabulation Tool accessed at https://faf.ornl.gov/fafweb/Extraction1.aspx

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[37] NFSP p 77

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[39] National List of Major Freight Highway Bottlenecks and Congested Corridors Federal Highway Administration (FHWA) Freight Mobility Trends: Truck Hours of Delay, 2019 https://ops.fhwa.dot.gov/freight/freight_analysis/mobility_trends/national_list_2019.htm

[40] 49 U.S.C. 70202(b)(6)

[41] Guidance on State Freight Plans and State Advisory Committees. https://www.federalregister.gov/documents/2016/10/14/2016-24862/guidance-on-state-freight-plans-and-state-freight-advisory-committees

[42] FHWA Condition and Performance Report 23rd Edition, p 12-4.

[43] The Louisiana Department of Transportation and Development 2019 Transportation Asset Management Plan pp 3-10, 3-11.

[44] Washington State Department of Transportation 2019 Transportation Asset Management Plan p 17.

[45] Massachusetts Department of Transportation 2018 Transportation Asset Management Plan p 11.

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[57] 23 CFR 515.13

[58] 23 CFR 490.107(b)(2) and 23 CFR 490.107(b)(3)

[59] 23 CFR 450.316(a)

[60] 23 CFR 450.306(d) and 23 CFR 450.324(f)(4)

[61] California Department of Transportation 2019 Transportation Asset Management Plan pp 2-5, 2-20.