

Linking Performance and Asset Management

A White Paper Produced by the Federal Highway Administration Transportation Asset Management Expert Task Group

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Linking Performance and Asset Management

This paper examines how the transportation asset management processes in 23 CFR 515, the transportation performance management processes in 23 CFR 490, and the planning requirements in 23 CFR 450 increase the linkage between asset management and performance management. This paper by the FHWA Transportation Asset Management Expert Task Group (TAMETG) builds upon an earlier paper produced in 2012 by the American Association of State Highway and Transportation Officials (AASHTO.) (Cambridge Systematics) That paper addressed how, in general, asset management and performance management are linked. This paper seeks to build upon that earlier work and explores how the specific regulations in 23 CFR 450, 490, and 515 support a performance-based asset management approach nationally.

Performance Management and Asset Management Defined

Both asset management and performance management support the Congressionally directed re-alignment of the Federal-aid program to be performance based as per U.S.C 23 Sec. 150. Congress in drafting the Moving Ahead for Progress in the 21st Century Act (MAP-21) included an emphatic declaration that performance management will transform the Federal program and be the means to support the national goals of

- Reducing traffic fatalities and serious injuries on all roads
- Maintaining the highway infrastructure in a state of good repair
- Achieving a significant reduction in congestion on the National Highway System (NHS)
- Improving the efficiency of the surface transportation system
- Improving the national freight network
- Sustaining the environment
- Reducing project delivery delays.

The FHWA has produced the following definitions and description of the relationship between performance-based planning and programming, performance management, and asset management.

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. (FHWA 2013)

Performance management is a strategic approach that uses system information to make investment and policy decisions to achieve national performance goals. (FHWA 2019a)

Asset management means 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 over the life cycle of the assets at minimum practicable cost.

The FHWA describes the relationship of asset management to performance management as:

“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.” (FHWA 2019b)

Balancing the Short Term with the Long Term

The combined effect of the performance, planning, and asset management regulations is to link performance targets to long-term objectives and then to cascade the targets through asset management strategies and the program of projects.

Asset management provides a framework for managing assets over their whole life at the least practicable cost. By its very nature, asset management takes a long-term view of what are not only the most effective short-term strategies but what are the most effective long-term strategies for managing assets. The asset management regulation in section 515.9 (d)(1) says the purpose of asset management is to achieve and sustain the desired state of good repair over the lifecycle of the assets at a minimum practicable cost. Inherent in asset management strategies is the need to invest in preservation, maintenance, and rehabilitation strategies that reduce the long-term, life-cycle costs of assets. However, these may not improve conditions in the short term.

At the same time, there is a need to report performance frequently to Congress and legislators during annual and biennial budget cycles. The combination of requirements in the Section 515 asset management regulation, the Section 490 performance management regulation, and the planning and programming provisions of Section 450, encourage both short-term and long-term asset management performance. They create a cycle where the asset management plan sets long-term objectives and investment strategies for managing assets. Then performance reports and consistency reviews measure if progress is being made as expected.

Section 490 requires the setting of bridge and pavement performance targets while establishing 2-year and 4-year reporting processes to address how actual performance compares to the targets. Those same targets are incorporated into the transportation asset management plan (TAMP) required under Section 515. The targets influence several sections of the TAMP including the gap analysis, life cycle strategies, the financial plan, and the investment strategies. Investment strategies are defined as a set of strategies that result from evaluating various levels of funding to achieve State DOT targets for asset condition and system performance effectiveness at a minimum practicable cost while managing risks. (23 CFR 515.15) Additionally, Section 515.13 requires an annual “consistency” report in which the State DOT indicates how it is implementing its asset management plan investment strategies as evidenced by its expenditures from the past year. Then, in each of the four-year Statewide and metropolitan Transportation Investment Programs (STIPs and TIPs) the State and regional planning agencies document the effect of the STIP/TIPs toward achieving the performance targets and how the STIP/TIPs link to the investment strategies. (23 CFR 450.18 and 450.134)

The short-term performance indicators referenced in 23 CFR 490, and the additional measures adopted by State transportation agencies, serve as short-term indicators that investment decisions are producing the desired results. The long-term state of good repair objectives in an asset management plan illustrate the future desired state of the assets. An analogy could be taking a long trip. The destination may be 500 miles from home. Landmarks along the way indicate the traveler remains on track and on schedule. With asset management, the intended destination is the state of good repair. The 2-year and 4-year targets discussed in 23 CFR 490 and the annual consistency reports, and the STIP/TIP analyses are the milestones along the way.

The combination of performance measures and asset management processes documented in the transportation asset management plan not only encourage better asset management decisions, but they allow for better illustration. The TAMP processes and performance results provide legislators and the public with evidence that agencies are managing assets with life-cycle processes. The asset management processes and the performance results illustrate that the agency is managing both for the short-term as well as for the long-term.

In 23 CFR 490.107 (c) the four-year performance reports for bridge and pavement condition targets are to include “to the maximum extent practicable” how the established targets support expectations documented in the longer-range plans such as the asset management plan. In addition, in 490.107 (J)(3) the progress reports are to include a discussion on the effectiveness of the investment strategies developed and documented in the State asset management plan.

During the annual asset management plan consistency review, FHWA will notify the State whether the State has developed and implemented the asset management plan consistent with the 23 U.S.C. 119. In making the consistency determination, FHWA will consider the most recent asset management plan submitted by the State DOT and any additional documentation the State provides. The State can determine the most suitable approach for demonstrating implementation of its plan if the information is current, documented, and verifiable. The submission must show the State DOT is using the investment strategies in its plan to make progress toward achievement of targets for asset condition and performance of the NHS, and to support progress toward the national goals. (23 CFR 515.13 (b) (2))

The FHWA says in 515.13 (b)(2)(i) that the best evidence of plan implementation to be that for the 12 months preceding the consistency determination that the State DOT funding allocations are reasonably consistent with the investment strategies from the asset management plan. This demonstration considers the alignment between actual and planned expenditures of the five work types. The work types are initial construction, maintenance, preservation, rehabilitation, and reconstruction. The linkage of the short-term consistency reviews to the strategies of the long-term TAMP assesses if the short-term program of projects is carrying out the long-term investment strategies.

The balance achieved between the short-term performance targets in CFR 490 and the long-term state of good repair focus in 23 CFR 515 can lead to meaningful asset management strategies. The performance measures, the long-term asset management plan and its financial plan, link together short-term performance, long-term whole-life strategies, and the financial realities facing agencies.

In short, the asset management plan’s long-term focus and the 23 CFR 490 short-term performance measures combine to tell the story of both current, and future, asset management conditions and trends.

Asset Management Stretches Limited Resources While Striving for Performance

For many State transportation agencies, expenditures for sustaining pavements and bridges are seriously constrained. The Washington State Department of Transportation asset management plan estimates an investment gap of \$1.33 billion for pavements and \$1.52 billion for bridges over 10 years to achieve the desired state of good repair. (WSDOT 2018a) The Kentucky Transportation Cabinet asset management plan indicates that only 9 percent of total revenues will be available for asset management investments once other obligations such as debt, operations, and revenue

sharing with local communities are “taken off the top.” (KYTC 2018a) The South Dakota Department of Transportation asset management plan indicates that nearly 42 percent of its total revenue will be required to sustain only its pavement condition targets. (SDOT 2018) The Pennsylvania Department of Transportation Statewide Transportation Improvement Program (STIP) for 2017-20 indicates that 67 percent of STIP expenditures are for bridge replacement and rehabilitation, Interstate maintenance, and highway restoration. (PennDOT 2017) Yet, the PennDOT TAMP forecasts substantial shortfalls in investments in the later years of the asset management plan. (PennDOT 2018)

Asset management provides the means to stretch limited dollars by using practices such as life-cycle planning, quality information, and bridge and pavement management systems. The Washington State DOT estimates that by 2025 it would cost an additional \$80 million annually to achieve its projected conditions if it were not deploying asset management strategies. (WSDOT 2018b) The Kentucky asset management plan says the agency’s pavement life cycle approach reduces the percentage of poor pavements by 49 percent over 10 years compared to a worst-first strategy. (KYTC 2018b) The New Jersey Department of Transportation TAMP reports that the same level of pavement spending using a worst-first strategy produces substantially lower pavement conditions than does the same expenditure with an optimized investment approach. (NJDOT 2018)

In all the cases mentioned in the preceding paragraph, a long horizon of 10 years or more is necessary for the savings from asset management to be apparent. If viewed in only one-or-two-year increments, a worst-first approach would yield higher short-term conditions. However, the short-term gains would mask lower long-term conditions unless the analysis extends for 10 years or more. The asset management plan with its long-term horizon and the 2-year and 4-year performance reporting in 23 CFR 490 complement each other to measure current performance but to also encourage long-term life-cycle investments.

Adopting Meaningful Investment Strategies to Ensure Long-Term Performance

The asset management regulation in 23 CFR Sec. 515 attempts to encourage the development of meaningful performance objectives, targets, life-cycle processes, and investment strategies recognizing the agency’s usually limited resources. The asset management regulation in 515.9 (d)(3) requires a summary description of the condition of NHS pavements and bridges based upon the national NHS performance measures. Additionally, a performance gap analysis is required, which is the gap 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)

Several of the transportation asset management plans illustrate how gap analysis can lead to identifying effective investment strategies. The Utah Department of Transportation used its pavement management system to determine that an increasing number of its aging high-volume pavements require reconstruction and were beyond the point that preservation or rehabilitation were appropriate. (UDOT 2018) An additional \$50-million-a-year annual pavement reconstruction program was developed to close that gap. The WSDOT asset management plan identified more than 50 percent of its concrete pavement lane miles are more than 40 years old and create the need for an investment strategy to focus upon them to address a long-term gap. The Rhode Island TAMP emphasizes its substantial increase in bridge investment to address the 18.23 percent of its NHS

bridges that are poor (RIDOT 2018) and which represent its largest asset management gap. RIDOT focuses a large up-front investment on bridges to deploy a balanced mix of replacement, rehabilitation, and preservation to achieve the Federal minimum conditions by 2025. The TAMP emphasizes the agency's increased focus on preservation and rehabilitation reflects the agency's new asset management approach and its intent to close its condition gaps.

Several State TAMPs illustrate how the agencies are using their management systems to develop investment strategies that achieve their condition targets for the least long-term cost. RIDOT uses the BrM bridge management to analyze the ways in which the performance gap will develop over time. It runs BrM to predict the condition of its bridges and to identify the most efficient long-term investment strategies. The Wyoming Department of Transportation (WYDOT 2018a) documents the use its management system to minimize the life-cycle cost of its infrastructure while maximizing its value with constrained funding. WYDOT uses its management systems to determine the best point to apply treatments in each asset's life cycle. It runs multiple scenarios using various funding and rehabilitation strategies to determine the best mix of projects with its available funding.

The Minnesota Department of Transportation demonstrated in its asset management plan investment horizons of up to 70 years to demonstrate the most economical life cycle strategies based upon its bridge and pavement modeling. (MnDOT 2018) For example, its TAMP indicates that the per lane mile cost per year for an asphalt pavement over 70 years would be \$15,800 dollars under a worst-first approach. Using its current life-cycle approach, the per lane mile annual cost is \$9,400. The TAMP estimates that if MnDOT could further perfect its life cycle approach, the per lane mile cost could be as low as \$6,000 annually. Similarly, for bridges, it identified a per-bridge life cycle cost as a percentage of initial construction of 152 percent under a life-cycle approach compared to 216 percent under a worst-first approach.

Balancing Asset Performance with Other Goals and Objectives

The asset management plan investment strategies are tempered by the need to achieve performance targets and objectives for highway safety, congestion, freight, and other areas identified by the States and regions. 23 CFR 450 requires that the planning process incorporate the objectives and targets for the entire performance-based Federal program, and not only for assets listed in the asset management plan. States must integrate into their plans the goals, objectives, performance measures, and targets for the Highway Safety Improvement Plan, the State Highway Safety Plan, Transit Asset Management Plan, the Public Transportation Agency Safety Plan, and the State Freight Plan. (CFR 23 450.206) Additionally, the MPO long-range plans must include the goals, objectives, performance measures, and targets of the asset management plan, Transit Asset Management Plan, the Public Transportation Safety Plan, appropriate portions of the State Freight Plan, and the Congestion Mitigation and Air Quality Improvement Program performance plan.

Telling the Asset Management and Performance Story

The FHWA noted in an international scanning report it produced while MAP-21 was under development that international transportation agencies reported that one of the major benefits of performance management was improved transparency. The transparency seen abroad in international performance management systems improved understanding about transportation issues and led to a greater degree of trust between agencies and legislators. The report said that greater understanding of asset condition and needs allowed agencies to tell their story effectively.

The initial asset plans provide examples of several agencies demonstrating that their life cycle strategies and preservation-first approaches are providing a return on investment. The Wyoming asset management plan shows that Statewide by 2030 about 21 percent of all pavements will be poor under its current life-cycle approach. If it had retained its pre-2014 worst-first strategy, by 2030 the percentage of the State system with poor pavement conditions would be more than 35 percent. (WYDOT 2018b)

The Ohio Department of Transportation Asset Management plan reports that its life-cycle approach to pavements has the potential to achieve the same condition level but cost between \$75 million to \$121 less million annually. (ODOT 2018) The plan also estimated that if it increased preservation activities by 5 percent on the NHS bridges, then the agency could save \$50 million annually after it reached a steady state for its conditions.

The Kentucky Transportation Cabinet asset management plan reports that the agency will by 2027 face a \$579 million backlog of unmet pavement-investment needs. However, if the agency was not implementing a balanced life cycle approach to its pavements, the 2027 backlog would be \$1.223 billion.

Asset Management Supports Analysis of Investment Needs

The initial asset management plans produce many examples of agencies telling their story of how they are maximizing their resources but still may not be able to achieve condition targets with available resources. The Michigan Department of Transportation (MDOT) Asset Management Plan recounts in detail how the agency maximizes its resources with life cycle strategies, and how the Legislature increased transportation investment. Nonetheless, it still reports that it will be \$638 million short over 10 years in the funding needed to achieve the minimum Federal condition threshold of no more than 5 percent of Interstate Highway System pavements in poor condition. (MDOT 2018) The TAMP says that even if all NHS pavement funding was directed to the Interstates, the agency still would lack enough to achieve the 5 percent threshold. The agency faces an \$8 billion shortfall over 10 years to achieve its pavement targets for the entire NHS. For bridges, the agency reports that it can achieve the Federal minimum of no more than 10 percent poor deck area over 10 years. However, to achieve its target of no more than 5 percent poor, MDOT would need an additional \$150 million over 10 years.

The PennDOT TAMP reports that a focus on bridge management and increased investment provided by the legislature led to a substantial increase in Statewide bridge conditions. However, it forecasts substantial increases in bridge and pavement deficiencies after 2022. It attributes the forecasted deterioration to inadequate funding, the increased age of the assets, and perhaps models that may not be precise enough to forecast accurately beyond five years.

The Illinois Department of Transportation asset management says on its second page that the agency lacks the resources to maintain the existing State system at a desired state of acceptable condition. It states that without additional revenues asset conditions will continue to deteriorate and performance objectives will not be met. It also states that the agency is shifting its approach from an explicitly worst-first approach to one that relies on preservation to lower life cycle costs.

The Minnesota DOT TAMP also provides a long-term forecast of declining revenues and worsening conditions despite efforts to stretch available dollars and optimize the agency's investments. It says the agency has shifted to focus on maintaining the existing state highway system while making limited mobility investments. (MnDOT 2018a) The plan states that to

maintain the highway infrastructure in current condition over the next 20 years it would require almost \$21 billion which would consume almost its entire capital program. The asset management plan also states that the agency will shift from a builder of the system to a maintainer and operator. (MnDOT 2018b) After 2023, the investments will include no mobility projects while investments in pavements, bridges, and roadside infrastructure increase to sustain conditions.

The Minnesota DOT's plan reports that over a longer period of 20 years that conditions will deteriorate significantly below target unless investments are increased. Although Interstates and NHS conditions will be prioritized, the percentage of poor Interstate and NHS pavements will be twice as much as the condition targets. For non-NHS pavements, 18 percent of the network is forecast to be in poor condition by 2037. For bridges between 7 percent and 8 percent will be poor for structures off the NHS. That deterioration will occur even if all funds are allocated to asset management and none to mobility projects. (MnDOT 2018c)

Summary and Conclusion

In this performance-based era, the asset management plan becomes an essential component of a continuous performance-management cycle. It both articulates long-term objectives for managing assets economically while also indicating annual investment levels necessary to progress toward the long-term state of good repair. The TAMP investment strategies can ensure that the focus on performance adequately captures the long-term benefits of life-cycle planning which would not be apparent in the short-term. By measuring only short-term conditions, a worst-approach may appear attractive. But with the asset management plan's long-term horizon, the return on investment of life-cycle investments become apparent.

Although the TAMP takes a 10-year perspective, its annual consistency review and the biennial performance reports serve to illustrate if the investment strategies are on track to ensure long-term performance. In short, the long-range plan, the asset management plan, the biennial and quadrennial performance reports, and the annual consistency review combine to provide long-term objectives for asset management and short-term indicators that the objectives are being met.

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