IDENTIFYING AND MANAGING FINANCIAL RISKS IN A TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Federal Highway Administration

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16. Abstract

Transportation agencies strive to provide a safe and functional transportation system that delivers the highest possible level of service and enables the efficient movement of people and goods. Unexpected or unplanned events, such as revenue disruptions and natural hazards, can impact a State DOT's ability to provide the desired level of service. Managing these uncertainties through risk management is an integral part of modern leadership practices and a key component to transportation asset management (TAM). Risk management is also one of the minimum requirements to include in a Transportation Asset Management Plan (TAMP) under 23 U.S.C.119(e).

This report builds on information gathered from developing State Departments of Transportation case studies on identifying and managing financial risks. This report summarizes the common financial risks considered in State DOT TAMPs and how these factors influence the development of TAMP investment strategies. Approaches to managing these risks are provided with examples showing how State DOTs have put these strategies into practice. Finally, keys to success are provided.

The document may be useful to State, local, and metropolitan transportation planning agencies interested in finding strategies that help reduce the negative impacts of financial uncertainty.

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LIST OF ABBREVIATIONS

BIL	Bipartisan Infrastructure Law
CTDOT	Connecticut Department of Transportation
CFG	Consensus Forecasting Group
DOT	Department of Transportation
EV	Electric Vehicle
FDOT	Florida Department of Transportation
FHWA	Federal Highway Administration
KYTC	Kentucky Transportation Cabinet
MDOT	Michigan Department of Transportation
MTF	Michigan Transportation Fund
NCHRP	National Cooperative Highway Research Program
NHS	National Highway System
PennDOT	Pennsylvania Department of Transportation
PEL	Planning and Environmental Linkages
REC	Revenue Estimating Conference
SOGR	State of Good Repair
STTF	State Transportation Trust Fund
TAM	Transportation Asset Management
TAMP	Transportation Asset Management Plan
TRENDS	Transportation Revenue Estimator and Needs Determination System
TROC	Transportation Revenue Options Commission
TxDOT	Texas Department of Transportation
UTP	Unified Transportation Program
VDOT	Virginia Department of Transportation
VMT	Vehicle Miles Traveled

SECTION 1: OVERVIEW

Introduction and Purpose

Transportation agencies strive to provide a safe and functional transportation system that delivers the highest possible level of service and enables the efficient movement of people and goods. Unexpected or unplanned events such as revenue disruptions and natural hazards can impact a State DOT's ability to provide the desired level of service. Managing these uncertainties through risk management is an integral part of modern leadership practices and a key component to transportation asset management (TAM). Risk management is also one of the minimum requirements to include in a Transportation Asset Management Plan (TAMP) under 23 U.S.C.119(e). In accordance with 23 U.S.C. 119(e), a State asset management plan must include:

- A summary listing of the pavement and bridge assets on the National Highway System (NHS) in the State, including a description of the condition of those assets.
- Asset management objectives and measures.
- Performance gap identification.
- Lifecycle cost and risk management analyses.
- A financial plan.
- Investment strategies.

Section 11105 of the Infrastructure Investment and Jobs Act, also known as the Bipartisan Infrastructure Law (BIL), Pub. L. No. 117-58, amended the TAMP requirements by requiring that States take into consideration extreme weather and resilience in their lifecycle cost and risk management analyses [23 U.S.C. 119 (e)(4)(D)]. Resilience, with respect to a project, is defined as "a project with the ability to anticipate, prepare for, or adapt to conditions or withstand, respond to, or recover rapidly from disruptions, including the ability (A(i)) to resist hazards or withstand impacts from weather events and natural disasters; or (ii) to reduce the magnitude or duration of impacts of a disruptive weather event or natural disaster on a project; and (B) to have the absorptive capacity, adaptive capacity, and recoverability to decrease project vulnerability to weather events or other natural disasters." (23 U.S.C. 101(a)(24)).

In developing their TAMPs, State Departments of Transportation (DOTs) identified a variety of risks that could affect system performance. In 2017, the FHWA published guidance on incorporating risk management into a TAMP (FHWA 2017a). The guidance identified the following common risk categories:

- Current and future environmental conditions—including those related to extreme weather, climate conditions, or seismic activity.
- Financial risks—including the uncertainty surrounding financial assumptions, inflation forecasts, and cost fluctuations.

- Legal or compliance risk—including changes in legal requirements that introduce uncertainty or variability into a financial plan.
- Demand risks—including changes related to land use, population shifts, and vehicle weights and volumes that influence the demand on transportation assets.
- Information and decision risks—including the quality of the data, forecasts, projections, and assumptions used to prepare the TAMP.
- Operational risks—including loss of staff expertise due to retirements or down-sizing, shifts in internal priorities, or project-development delays that could impact asset performance.
- Hostile acts, malfeasance, and accidents—including criminal acts and threats related to fires or accidents that impact the level of services that can be provided.

The consideration of risks in a TAMP enables transportation agencies to be more informed about the factors that impact asset performance. As TAMPs evolve over time and new analysis tools become available, the understanding of these factors will likely improve. To support this evolution in practice, this document was developed to focus on strategies for managing financial and organizational risks. This report presents suggestions for using available information to advance the sophistication with which financial risks are managed. It provides examples intended to strengthen existing risk management processes by illustrating approaches to:

- Defining risks effectively.
- Quantifying risk impacts.
- Developing risk management strategies.
- Communicating results effectively.

Managing Risks

A variety of resources provide information on risk management processes for identifying, analyzing, evaluating, and managing risks (AASHTO 2016, ISO 2009). The FHWA provided the graphic shown in figure 1 in its risk management guidance (FHWA 2017a). The figure outlines the 5-step process that can be followed to manage a variety of risks.

As reflected in the figure, risk management is a continuous process. Communicating and consulting typically involve recognizing the importance of documenting and sharing risks and working with key stakeholders to evaluate and manage critical risks. Agencies generally use a risk register to summarize the top risks, their potential impacts, and plans for managing risks. A strong risk register assigns responsibility for each risk mitigation strategy with a progress schedule that can be monitored with time. As changes to the likelihood of an event occurring or the potential impact to the State DOT increases or decreases, risk registers can be updated so that modifications to risk management strategies are considered. When risk management is fully incorporated into State DOT processes, risks to performance can help better influence Long-Range Strategic Transportation Plans, strategic and financial plans, TAMP investment strategies, budget testimony, and other performance-based planning activities.

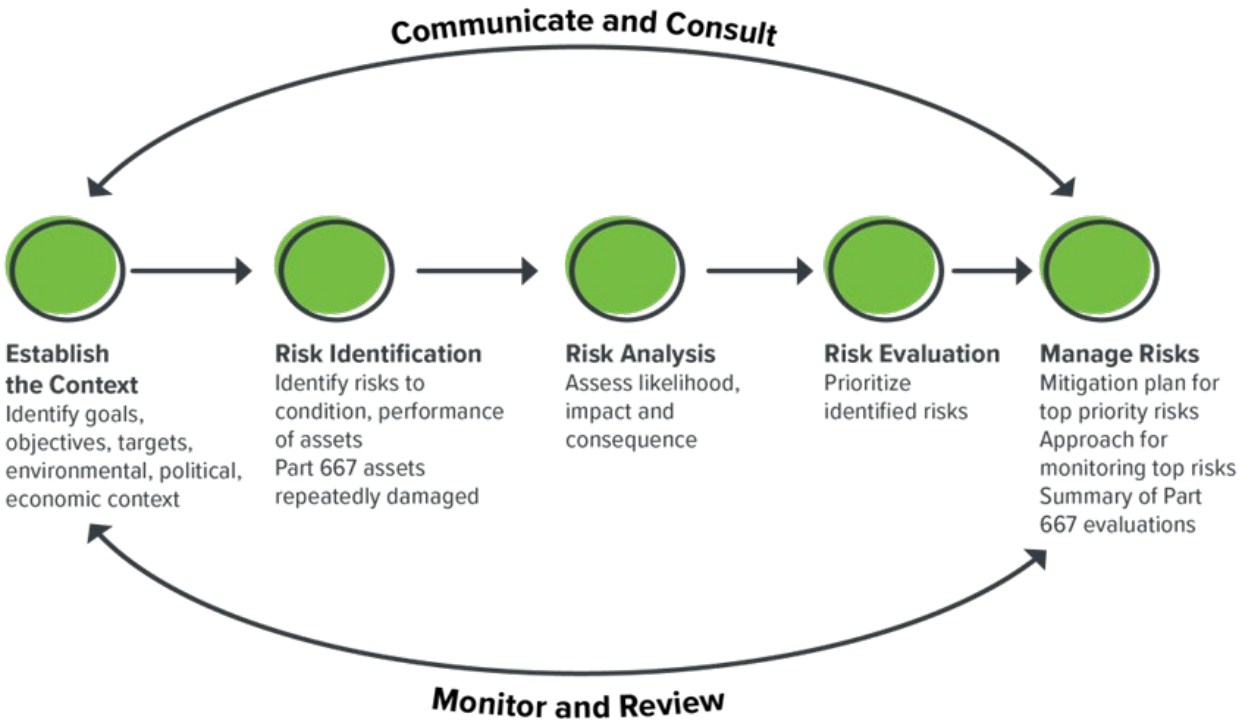


Figure 1. The risk management process (FHWA 2017a).[1]

Document Organization and Use

This document consists of five sections, including this introductory section. A description of each section is provided below:

- Section 1: Overview. This section introduces the FHWA's reason for developing this documentation to help agencies manage funding uncertainty. It describes relevant requirements related to risk management and summarizes an approach for managing risks.
- Section 2: The Importance of Managing Financial Risks. This section summarizes the common financial risks typically considered in State DOT TAMPs and how these factors influence the development of TAMP investment strategies.
- Section 3: Approaches to Managing Financial Risks. This section introduces four approaches that are being used to manage financial risks. These strategies include:
  - Monitoring Revenue, Inflation, Costs, or Other Parameters.
  - Forecasting and Scenario Development.
  - Ensuring a Steady Investment in Asset Preservation.
  - Exploring Alternative Revenue Sources.

[1] *Original data sources for this graphic include: ISO 2009 and AASHTO 2016, located in the References.*

- Section 4: Putting It Into Practice. This section provides examples of each of the four strategies introduced in section 3.
- Section 5: Keys to Success. The final section summarizes several factors that influenced the success of each strategy in managing financial risks.

An appendix presents publicly available resources that were suggested by State DOTs highlighted in the document or identified through a literature search of available print materials.

The document may be useful to State, local, and metropolitan transportation agencies interested in finding strategies that help reduce the negative impacts of financial uncertainty. It builds the case for recognizing the importance of managing financial risks and presents successful strategies that have been used by State DOTs to address this uncertainty. It concludes with success factors and a summary of resources that can assist agencies with implementing one or more of the suggested strategies.

SECTION 2: THE IMPORTANCE OF MANAGING FINANCIAL RISKS

Introduction

Sustainable asset performance benefits from the development of long-term financial plans linked to cost-effective lifecycle strategies. TAMPs portray annual investment needed for asset maintenance, preservation, rehabilitation, and reconstruction in conjunction with the 10-year financial plan. Ideally, this level of investment should be linked to performance and condition objectives so that progress can be monitored and reported to stakeholders.

A typical TAMP financial plan includes forecasts of expected funding levels and funding sources and planned investment strategies to address asset management needs. Gaps between the allocations and the amounts needed to meet strategic objectives are summarized in a performance gap assessment. More information on the development of financial plans is available in two FHWA documents: *Managing Risks and Using Metrics in Transportation Asset Management Financial Plans* and *Developing TAMP Financial Plans*. (FHWA 2015, FHWA 2017b). These documents present the link between expected revenue forecasts and their ability to meet the asset investment needs generated by the State DOT's bridge, pavement, or maintenance management systems.

Long-term underfunding of asset needs accumulates a growing liability that eventually should be addressed. The cost of underfunded pavements and bridges manifests in terms of poor conditions, increased repair costs, and less safe conditions that are not reflected or acknowledged in budgets or long-range plans (FHWA 2015). These impacts can be presented in a TAMP in the form of a gap assessment. Managing the uncertainty associated with these 10-year projections reduces the likelihood that the consequences associated with financial risks will divert a State DOT from its asset management objectives.

Types of Financial Risks

During the literature search conducted for this project, 2018 and 2019 TAMPs for each State DOT were reviewed. Many of these TAMPs acknowledged financial risk as a significant factor impacting the States' ability to plan 10-year investment strategies. These financial risks were commonly defined as uncertainty associated with future revenue, uncertainty in agency costs, or both. Examples of risk statements extracted from several TAMPs are highlighted below. While all examples originate from the 2018 and 2019 TAMPs, specific sources are not provided since these examples are offered only to illustrate the range of financial risks recognized by State DOTs.

Uncertainty in Future Revenue

Risks associated with uncertainty in future revenue vary widely. They range from concerns associated with Federal funding (including the availability of State matching funds) to the financial collapse of a privately-owned toll facility. Examples from the 2018 and 2019 State DOT TAMPs are listed below:

- Cuts in available funding reduce the ability to fund projects and perform maintenance.
- The State's inability to match Federal funds hinders our ability to fully leverage Federal resources.
- If actual funding is below current projections, less work will be completed and safety will be impacted.
- Current funding levels are not sufficient to address capital and maintenance project needs.
- If there is an economic downturn and impact on fuel tax revenue, it can increase/decrease available funding.
- Increases or decreases in bond ratings may influence available funding to address performance needs.
- If the legislature does not support adequate and stable funding, we will not be able to make the systematic and regular investments needed to treat assets at the right time.
- If funding is unpredictable, we may not be able to optimize our paving treatments.
- The diversion of funds to high-profile projects reduces available funds for bridge and pavement programs.

Uncertainty in Agency Costs

Many State DOTs included financial risks associated with fluctuations in the costs of labor and materials, as illustrated below:

- Major projects with cost overruns impact budgets for other activities, which lowers the level of service that can be provided.
- There is significant volatility in commodity pricing that makes financial planning difficult.
- If labor costs increase or there is a shortage of skilled workers, agency costs will increase, and we may not be able to achieve the desired performance.
- The State DOT's ability to efficiently deliver programs is undermined due to construction costs or supply chain disruptions.
- Cost assumptions for standardized treatments in the TAMP may not accurately reflect average costs in the field, which vary across the State.
- If project costs rise at a faster rate than revenues, the ability to maintain the condition of our bridges could force the State DOT into "worst-first" decisionmaking.

Other Financial Risks

Other examples of financial risks included in the State DOT TAMPs are included below:

- If the number of assets increases without a corresponding increase in revenue, there will be a net reduction in maintenance across all assets.
- If unexpected funding is made available, the State DOT will not be able to respond because an insufficient number of projects are ready to be constructed.
- A new administration may change assumed priorities relative to plan goals for condition achievements, funding allocations, staffing, project selection, and other infrastructure improvements.
- If the population continues to shift to urban areas, then additional funds may be allocated to non-asset management needs, decreasing asset management funding statewide.
- If there is not sufficient funding for data collection and data maintenance, then asset inventories will be incomplete and unreliable.
- If our estimated rates of deterioration are not reflective of field conditions, estimated needs will be higher or lower than those presented.
- Since snow removal must be funded regardless of other plans for those funds, any inaccurate modeling of snow needs may lead to decreased funding for pavement and bridge maintenance, reducing the planned activities for those assets.

Framing Financial Risks

The range of financial risks included in the State DOT TAMPs illustrates the diverse challenges that State DOTs face in developing and implementing their TAMPs.

There are challenges with trying to manage these risks since uncertainty in both future funding and agency costs are often outside of a State DOT's control. Further, State DOT processes for managing asset management risks, preparing financial plans, and developing TAMPs are still relatively new and evolving. As a result, many of the strategies described in State DOT TAMPs for mitigating financial risk are described in a generalized manner and may be difficult to put into practice.

Another complicating factor relates to the way risks are framed. If a risk is framed too broadly, it may be challenging to fully recognize the potential impacts and develop effective strategies for mitigation. As a result, State DOTs may not recognize the opportunities available for understanding and managing financial risks.

> TIP: Financial risks should be framed so the cause and impacts are understood. This will help in developing an effective mitigation strategy.

In its 2022 TAMP, the Colorado DOT had two aspects of financial risk among its top 10 risks: funding uncertainty and cost uncertainty (CDOT 2022). The DOT recognized the risk associated with funding changes that could increase or decrease investments that had the potential to either improve or diminish asset management objectives. This type of risk is managed on a per event basis so appropriate action can be taken. The other risk, cost uncertainty, recognizes that price escalation may occur, which could lead to unsustainable costs that limit the State DOT's ability to deliver its organizational

> TIP: Managing financial risks is important since they can significantly influence whether strategic objectives are achieved.

objectives. This risk is managed through the bid process by rejecting bids if necessary, rescoping projects, or price hedging.

An FHWA reference further illustrates the importance of outreach as a key to managing financial risks. As shown in table 1 (FHWA 2015), the risk register includes mitigation actions that include monitoring Federal funding, but also outlines responsibility for the asset management and Federal liaison to keep stakeholders apprised of situations so program adjustments can be made if necessary.

Table 1. Example risk register with recommended actions for a Federal funding risk (FHWA 2015).

Federal Funding Risk	Likelihood	Consequence	Value	Comments	Action Required	Status
Federal-aid funding could fall below projected levels which would necessitate reductions in the asset management funding levels and could require reducing treatment targets or diverting resources from other programs.	Moderate	Significant	High	No certainty exists for if and when transportation appropriations will be reauthorized or at what level.	Continued monitoring and outreach to keep stakeholders apprised of status and potential consequences	Requires continuous monitoring

As these examples illustrate, it is important to have a clear understanding of the cause of financial risks and their potential impacts. This understanding provides an opportunity to develop a sound mitigation strategy that clearly communicates how the risk will be managed and who has responsibility for recognizing and addressing any changes.

Potential Impacts of Financial Risks on TAMP Investment Strategies

Financial risks pose potential impacts on a State DOT's ability to implement its TAMP financial plan. Recognizing these potential impacts is helpful in selecting a mitigation approach and preparing for potential shortfalls that may occur. Several examples of potential impacts from financial risks are presented.

Loss of Credibility Due to Funding Shortfalls or Windfalls

A TAMP financial plan presents a 10-year assessment of a State DOT's typical revenue sources, expected levels of funding, and planned revenue allocations. It provides a snapshot of the State DOT's financial state as well as the funding needs to achieve its goals and objectives. The TAMP financial plan can also convey any gaps between expected and needed funding levels, serving as a communication tool with the public and other stakeholders. It also lends a sense of transparency to the State DOT's transportation system stewardship.

Without a clear recognition of the uncertainties associated with Federal and State funding sources, stakeholders may question the State DOT's credibility if funding shortfalls prevent the State from achieving its objectives. The same may be true if funding levels exceed expectations, with stakeholders possibly interpreting the TAMP financial plan as being overly conservative to secure additional funding. By acknowledging the likelihood of financial risks in the TAMP, and stating the assumptions made, State DOTs have an opportunity to inform stakeholders of the uncertainties they face on a regular basis.

Under or Overestimating Planned Future Needs

Pavements and bridges are long-lived assets that benefit from long-term planning, such as that used in a TAMP. With the inclusion of a gap assessment to convey any differences between expected and needed funding, the TAMP serves as a vehicle to communicate additional funding needs. The unfunded needs in a gap assessment are often referred to as "deferred" needs.

As a TAMP demonstrates, continued underfunding of investments in long-term assets leads to growth in the total amount of funding required to cover deferred needs. Although the gap assessment provides an estimate of these needs, they are not typically reflected in financial statements or other fiscal plans presented to stakeholders. As a result, stakeholders may not have a good understanding of the level of funding needed to preserve system conditions.

TIP: Continued underinvestment in assets can result in a growing financial liability in terms of deferred needs.

As shown in the 2015 FHWA report *Managing Risks and Using Metrics in Transportation Asset Management Financial Plans*, financial risks can have a significant impact on estimating the size of the deferred needs. As an example, it showcases the differences in deferred needs at two different inflation rates. It is assumed that $304 million is spent on a single asset class in year one of the 10-year plan. At an annual 2 percent rate of inflation, the asset budget need at the end of the 10-year plan increases to $371 million, which is an increase of $67 million from the first plan year. If, however, the actual annual inflation rate increases to 5 percent over the 10-year plan, the asset needs in year 10 increase to $495 million. This is an increase of $191 million above the needs in the first plan year and $124 million more than the 10-year need under a 2 percent inflation scenario. If the agency had underestimated the inflation rate, projects would have to be deferred in later years of the plan, money would have to be transferred from other plans, or asset conditions would fall below expectations. If the agency had overstated the assumed inflation rates, it might have postponed projects that otherwise could have been funded to address safety, mobility, or asset preservation needs.

TIP: The difference between a 2 percent and 5 percent annual rate of inflation can have a significant impact on estimating the level of funding required to address future needs.

False Sense of Confidence in Projected Conditions

Ignoring the potential for financial risks could result in overconfidence at many levels, including available funding, the number of fundable projects, and achievable performance. If funding is below expectations, this could lead to unrealistic expectations among stakeholders and reactive strategies that tend to be short-term fixes.

Missed Opportunities

The consideration of financial risks, along with the analysis results, can help State DOTs prepare for changes that could impact funding levels, strategic goals, and the expected level of service. This knowledge creates an opportunity to prepare for these changes, allowing legislators and other decisionmakers long lead times to anticipate methods for closing financial gaps. For example:

- As the number of electric and hybrid vehicles on the road increases, the revenue generated by fuel-based taxes can be expected to decrease. This provides an opportunity to begin exploring alternate sources of revenue to offset the decreases. It also offers a chance to engage legislators and key stakeholders in generating feasible solutions to address the revenue shortfalls that could occur.
- The analysis of potential financial risks also provides an opportunity to begin planning for strategies that may be necessary should other types of forecasted shortfalls occur. These strategies may include planning for bond issues years in advance or shifting funding from one program to another if potential financial risks occur.

Why Managing Financial Risks Is Important

Many financial risks are outside State DOTs' control and can materialize from a variety of political decisions, economic growth factors, and market forces. These forces have the potential to impact how revenue and costs will vary over the 10-year period included in the TAMP. Recognizing the potential impacts financial risks may have on a State DOT's investment plan is helpful in selecting a mitigation approach, which commonly involves monitoring, tolerating, or reacting to them.

In State DOTs with strong performance-based management programs, uncertainty is considered in planning and programming processes. The formal risk assessments that are inherent in TAMP development provide the types of useful information that support long-term asset management planning and achieve strategic objectives. The ongoing monitoring that is part of performance management encourages tracking and reviewing factors that impact outcomes to enable the State DOT to hedge financial risks effectively.

In general, efforts to manage risks benefit State DOTs by:

- Providing time to plan strategies to offset the potential impacts of financial shortfalls.
- Predicting trends that could eventually impact prices, revenue, or other financial considerations.
- Minimizing the negative impacts of financial risks.
- Preparing a planned, strategic approach for adjusting to unexpected events.
- Building an understanding of potential consequences.
- Incorporating credibility and accountability into the planning and programming process.
- Enhancing communication with key stakeholders.

SECTION 3: APPROACHES TO MANAGING FINANCIAL RISKS

Strategies for Managing Financial Risks

During the development of this document, a literature review was conducted focusing primarily on State TAMPs and reports that summarized information from the State TAMPs. Due to the project's timing, the TAMPs available for the literature review included the 52 initial and fully compliant TAMPs submitted to the FHWA Division Offices in 2018 and 2019. The 2022 TAMPs were not available at the time. The 2018 and 2019 TAMPs represented a wide range of approaches and levels of sophistication for implementing asset management. The State DOTs varied significantly in their approaches to asset management, the resources available to support its implementation, and the degree to which asset management influences investment decisions. The strategies showcased in this section reflect those variations.

This section introduces four strategies for managing financial risks that emerged from the literature review:

- Strategy 1: Monitoring Revenue, Inflation, Costs, or Other Parameters.
- Strategy 2: Forecasting and Scenario Development.
- Strategy 3: Ensuring a Steady Investment in Asset Preservation.
- Strategy 4: Exploring Alternate Revenue Sources.

Strategy 1: Monitoring Revenue, Inflation, Costs, or Other Parameters

State DOTs recognize that many financial risks are outside of their control, so a common mitigation strategy implemented is to tolerate them. Adding regular monitoring to identify changes in trends that might impact investment decisions adds a level of protection by prompting appropriate reactions. If monitored factors change frequently, a State DOT may determine that the TAMP assumptions need to be updated at least annually to reflect the changing conditions.

The literature review found 16 TAMPs indicated that revenue costs or other parameters are monitored to identify situations where adjustments are needed quickly. For instance, the Arizona DOT TAMP indicates its response to funding uncertainty is to "actively monitor revenues and prepare monthly financial reports for management and State Transportation Board review (ADOT 2019)."

Tracking Revenue Trends

By tracking revenue trends, agencies can anticipate the need to plan for possible shortfalls or windfalls in revenue. Based on the information provided in State DOT TAMPs, minor revenue fluctuations may not be tracked since their impacts on planned investments may be minimal; however, changes in principal revenue sources, such as Federal-aid appropriations and fuel-related tax rates, can have a significant impact. In 2018 and 2019, State DOTs may have assumed that Federal-aid appropriations would remain constant. However, after the 2021 passage of BIL, several State DOTs may have made different projections in preparing their 2022 TAMPs.

Fluctuations in annual fuel consumption and the resulting gas tax revenues are impacted by the percentage of electric and hybrid vehicles on the road. These fluctuations may or may not be impacted by State fuel tax increases or indexing provisions that increase the tax rate in subsequent years. Vehicle registration fees are another funding source that can be used to offset fluctuations in fuel tax revenue. For example, the Michigan DOT (MDOT) TAMP indicates that "new electric car fees of $100 per year, and $40 per year for plug-in hybrid cars, equalize road-user fees for vehicles that use little or not taxed fuel" (MDOT 2019).

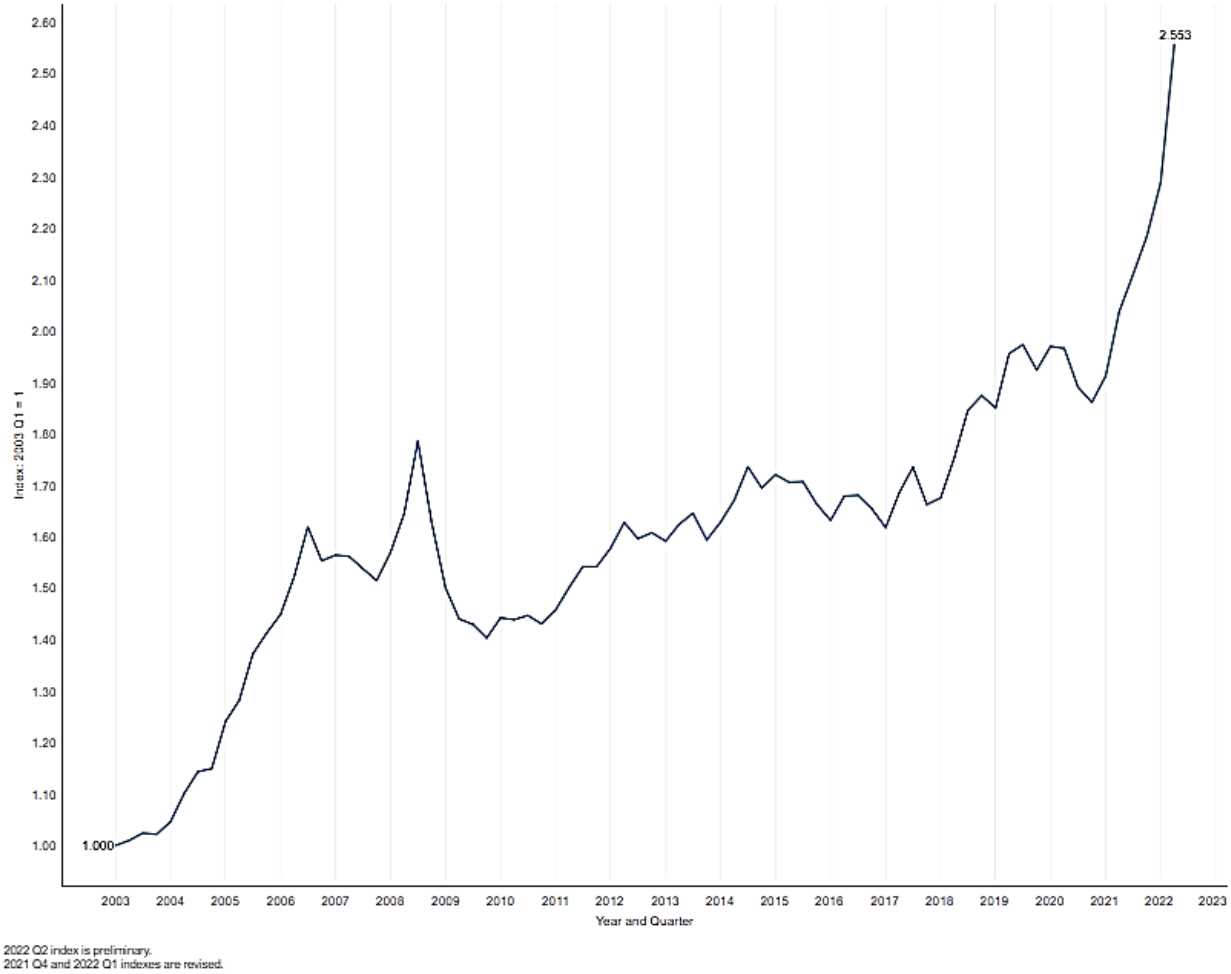
Wachs and Heimsath (2015) documented the state of the practice in revenue forecasting based on a survey of transportation agencies. The survey found that at least six agencies were using sophisticated regression models to predict future revenue as a function of variables such as vehicle registration, fuel consumption, and various measures of economic activity. The researchers also documented a probabilistic approach used by the Arizona DOT.

The Kentucky Transportation Cabinet (KYTC) established a Consensus Forecasting Group (CFG) for projecting future funding (KYTC 2019). The group monitors actual receipts and compares them to the funding projections to help manage the risk of revenue uncertainty. In the event of a funding shortfall, KYTC gives priority to pavement and bridge preservation and maintenance on the Interstate and National Highway Systems, reflecting the Cabinet's commitment to asset management.

Tracking Cost Trends

A variety of leading cost indicators may be monitored to determine whether actual conditions differ substantially from a TAMP's financial assumptions. Examples include national construction price trends, bid prices for key materials, and bidding trends. For example, national price-monitoring services can be used to track cost fluctuations in the expected price of key construction commodities. Tracking these types of costs can provide asset managers advanced notice that prices are changing so that assumptions incorporated into the TAMP can be updated and any necessary adjustments to the investment plan can be made.

Using trends to predict future scenarios can be difficult, especially if there are frequent changes in the values being monitored. For instance, figure 2 illustrates trends in the construction cost index over the past 20 years. A State DOT that based its 2018 and 2019 TAMPs on average inflation trends at that time would have a very different assumption for estimating construction costs at that time than when the 2022 TAMPs were prepared. A State DOT facing this type of variability may find it helpful to monitor construction price changes at least annually to determine whether the peak has passed or whether the construction cost index is continuing to rise. A State DOT may also find it useful to provide an indication of its level of confidence in its forecasts and the likelihood that cost increases could vary substantially from an annualized average.



Source: FHWA

Figure 2. 20-year annual construction cost index trends (FHWA 2023).

Strategy 2: Forecasting and Scenario Development

Under this strategy, State DOTs consider forecasted conditions under various scenarios to evaluate the long-term impacts caused by different situations. In scenario development, State DOTs recognize that they cannot precisely determine what the future has in store, so different approaches with plausible futures are envisioned. Each of these scenarios has potential outcomes that enables the investment plan to be flexible and responsive to the differing needs and priorities as the future unfolds. Pavement and bridge management systems support scenario development through the availability of performance models to estimate future funding needs.

Developing Scenarios

Scenario development provides an opportunity for a State DOT to consider a wide variety of uncertainty, including:

- Changes in traffic growth, population shifts, or other demographic shifts.
- Changes in the percentage of vehicles using non-taxed fuel sources.

- Uncertainty in the deterioration rates used in the pavement or bridge management systems to predict needs.
- Variations in revenue available to preserve transportation assets.
- Differences in approaches to preserving the system, such as increasing the use of low-cost preventive maintenance treatments.

Wachs and Heimsath (2015) indicate that the Texas DOT uses a scenario analysis program called the Transportation Revenue Estimator and Needs Determination System (TRENDS) for estimating revenue. The scenarios are based on a set of 22 different inputs, including assumptions for population growth, fuel efficiency, new capacity, vehicle registration fees, and Federal and State fuel tax variables.

A key to the success of the scenario strategy is to use the results to inform stakeholders of the potential outcomes. The South Dakota DOT recognized the importance of communication by indicating that its mitigation strategy includes informing and educating the State legislature on the risks and consequences associated with insufficient funding.

Improving Forecasting

Several TAMPs described risk mitigation approaches that specify improvements to cost-estimating models, asset performance models, treatment selection models, and prioritization rules. These enhancements are intended to improve the forecasting tools to minimize differences between planned and actual conditions. For instance, if asset performance models are overestimating the rate at which assets deteriorate, the planned investments are likely overestimating actual needs. Conversely, underestimating the rate of deterioration may lead to investment needs that are much higher than anticipated.

The Virginia DOT's (VDOT) TAMP recognized the uncertainty in winter maintenance costs as a financial risk that significantly impacted the funding available to address other asset needs (VDOT 2019). The TAMP indicated that VDOT is developing a Snow Model for better predicting winter maintenance needs. This does not address uncertainty in future funding but can help address uncertainty in costs.

Strategy 3: Ensuring a Steady Investment in Asset Preservation

Another strategy for reducing the potential revenue uncertainty impacts is to ensure a steady level of investment in preservation activities that slow the asset deterioration rate and defer future investment burdens associated with underfunded programs.

The foundation for this strategy was partially influenced by practices in Australia, where asset management plans have been used for years. There, local governments are responsible for developing financial and asset management plans to "ensure that the agencies remain fiscally solvent and do not accumulate deficits that will diminish services or require State bail outs" (FHWA 2015). Results from a local government infrastructure audit conducted for the New South Wales Division of Local Governments state that these plans have "led to increased spending on preservation and maintenance, greater understanding of long-term asset liabilities, and less tendency to build new assets that create future maintenance costs" (FHWA 2015).

The review of 2018 and 2019 TAMPs found that at least 13 State DOTs indicated that different investment strategies had been considered in their TAMPs through lifecycle planning. While the strategies evaluated vary, the analysis commonly compared a worst-first strategy—in which assets in poor condition are prioritized for funding—against preservation strategies that emphasized addressing assets before they fall into poor condition. These strategies typically show that higher conditions can be sustained over time at a lower cost when investments in preservation are prioritized. As these TAMPs demonstrate, preservation strategies are both an asset management strategy as well as a financial risk mitigation strategy.

Recognizing the importance of ongoing investments in asset preservation, the Florida legislature passed Florida Statute 334.046. This State statute establishes the preservation of the State's transportation infrastructure investment as a prevailing principle for the Florida DOT (Florida Senate 2018). This is translated into performance targets ensuring:

- 80 percent of the pavement on the State Highway System meets department standards.
- 90 percent of the department-maintained bridges meet department standards.
- 100 percent of the acceptable maintenance standard is achieved on the State Highway System.

With the need to fund preservation incorporated into State statute, the Florida DOT enjoys a high degree of confidence that sufficient funding will be received to meet these goals. As a result, some of the consequences typically associated with financial uncertainty are minimized.

Strategy 4: Exploring Alternative Revenue Sources

A strategy that might not be initially obvious to some transportation agencies is to explore alternative revenue sources to offset potential shortfalls. This strategy could include measures that result in additional revenue (e.g., increasing vehicle registration fees or issuing bonds) or shifting revenue between programs or areas (e.g., shifting funds from mobility to preservation). While not all alternate sources of revenue may be considered in every State, it is important to at least be aware of available options.

Sources of Alternate Revenue

The literature review identified seven TAMPs that indicate State DOTs have explored new or different revenue sources to address funding uncertainty. The types of revenue sources mentioned include bonds, tolling, increased gas taxes, or other user fees. For instance, one TAMP discusses the State DOT's efforts to maintain a high bond rating so that bonding is an option in the event of a shortfall. Several TAMPs identified the recent passage of an increase in the State's fuel tax as a source of additional revenue.

Using Bonds to Offset Revenue Needs

State DOTs can be limited to the amount they can borrow based on legislative limits and subject to the approval of State treasurers or budget officials.

Bonds are a common source of borrowing that can be used most effectively when timed to align with expected needs. Bonds are typically issued for 10- and 20-year periods. Since the TAMP provides a projection of funding needs for a 10-year period, State DOTs may have the ability to plan the timing of bond issues to follow the maturity of past bonds. Under this approach, the bond payment is already budgeted (since it had been paid for the maturing bond) and the State DOT realizes new income to offset investment needs. It may also be prudent to use borrowed funds to replace several large, high-cost assets that require ongoing, expensive maintenance treatments to reduce future maintenance costs (FHWA 2015). Under this scenario, the amount saved in terms of future maintenance cost reductions may cover the cost of bond financing.

Shifting Funds to Address Needs

Another approach to addressing revenue uncertainty is to have a plan for shifting funds between programs or areas should a potential shortfall materialize. This approach could involve several different strategies. For instance, a State DOT might reduce the amount planned to address large, capacity-building projects to offset asset preservation needs in the event of a shortfall. State DOTs could also consider creative approaches to stretching available funding, such as funding projects that restore pavement surface texture through a safety program since they contribute to a reduction in wet-weather crashes. In at least one instance, a TAMP describes an approach to increase the use of preservation treatments on very low-volume pavements and bridges to allow the agency to shift the savings toward higher-priority, high-volume preservation needs. The State DOT described this approach as a risk-reduction strategy since the cost of rebuilding deteriorated high-volume facilities in the future could require too large a percentage of future funding. By preserving the high-volume facilities, the State DOT is attempting to prevent those assets from deteriorating to the point that costly repairs are needed.

Addressing Unexpected Windfalls

Several State DOT TAMPs also established plans for addressing positive financial risks, such as the receipt of unexpected or increased funding. To help leverage these funds, some State DOTs indicated that they maintain a pool of projects that can be implemented quickly should additional funds materialize. Other State DOTs noted that they identified priorities ahead of time so it is clear where the additional revenue will be used should it become available.

SECTION 4: PUTTING IT INTO PRACTICE

Strategy 1 Examples: Monitoring Revenue, Inflation, Costs, or Other Parameters

Several agencies choose to monitor revenue, costs, or other parameters to identify situations in which TAMP financial plan adjustments could be needed. By staying closely aligned with the current financial trends, DOTs can mitigate the risk that the TAMP financial plan is out of sync with financial reality.

Florida DOT

The Florida DOT holds Revenue Estimating Conferences (REC) three times a year to consider the forecast of revenues flowing into the State Transportation Trust Fund (STTF) (Florida Senate 2000-2022a; Florida DOT 2022).

The RECs are the primary tool the Florida DOT uses to monitor and respond to funding changes. These conferences occur before, during, and after each legislative session to determine the anticipated impact of pending and enacted State legislation on State revenues. The timing of the REC process varies based on a biennial schedule. The initial REC occurs three months before the initial legislative session to inform the State governor of the current estimate of State revenues and the recommended budget. A second REC refines the forecast once the session begins. During the REC conferences, revenue predictions are typically conservative, and revenue collections are continually used to readjust the forecast.

In addition to the RECs, the Florida DOT monitors trends in construction cost indicators and incorporates these changes into its estimates to allow time to prepare for possible increases or decreases in costs. Construction cost indicators are discussed quarterly at the Executive Performance Review Meetings and inform ongoing projections.

Higher project costs sometimes result from price fluctuations of certain materials, coupled with the decreasing certainty of project bids. However, the Florida DOT has processes in place to deal with periodic changes in material costs and their impact on project bids. The Florida DOT overcomes these risks and provides stability by indexing fuel prices and bituminous materials to address material pricing uncertainty.

The Florida DOT uses its RECs as a mechanism for improving revenue projections and monitoring funding changes as part of a comprehensive forecasting strategy.

Michigan DOT

The major source of State funds for transportation in Michigan is the Michigan Transportation Fund (MTF), which includes gas taxes, registrations, and other revenues (MDOT 2023). Michigan DOT (MDOT) and the Department of Treasury work together to develop a short-range forecast. Separately, MDOT performs longer-range forecasts for its planning. The longer-range forecast incorporates the short-term forecast and MDOT's best estimates of future Federal funding. Estimates for Federal revenues are prepared at least once each calendar year and incorporate current debt service and payment schedules. Costs are estimated using cost-per-lane-mile assumptions to project and adjust costs for various construction types.

Over the course of the year, MDOT monitors both revenue and project costs. If revenue or costs differ from MDOT's plans, MDOT will adjust its capital program and TAMP (MDOT 2019) as needed. Typically, MDOT will either accelerate projects if additional funds are available or defer them based on reductions in revenue or increases in costs.

Employing an investment strategy development process, performing revenue and cost monitoring, and communicating with transportation stakeholders have resulted in several enhancements for MDOT. Ongoing monitoring ensures revenue and cost adjustments are made when needed. MDOT increases credibility and trust with the State Legislature and the traveling public by consistently sharing data, reports, and documents to communicate over 20 years of TAM accountability.

Strategy 2 Examples: Forecasting and Scenario Development

The long lifespan of transportation assets typically requires that agencies consider a similar time scale in planning efforts. Planning for multiple future scenarios helps DOTs be prepared for financial changes that can affect asset management investments.

Texas Department of Transportation

Texas DOT (TxDOT) models the effects of different funding levels on asset performance to depict the potential impact of reduced or increased investment. TxDOT uses three funding scenarios: reduced investment, current (planned) investment, and increased investment. Current planned investment levels are based on the funding laid out in TxDOT's *Unified Transportation Program* (UTP) (TxDOT 2023), the document that authorizes construction funding over a 10-year period. The alternative scenarios differ by asset.

In the 2022 TAMP (TxDOT 2022), TxDOT modeled a 10 percent increase and a 10 percent decrease in funding to show changes in pavement performance. These scenarios were used to model conditions for State-owned pavements, Interstate pavements, and non-Interstate NHS pavements. For bridges, TxDOT modeled current funding, a 50 percent funding increase, and a 25 percent funding decrease for State-owned bridges and NHS bridges. The results are shown in line charts, with each line representing asset condition over time in a particular funding scenario. The charts show the change in asset conditions over ten years and can be used to communicate the case for additional funding, or the cost of reducing funding.

Connecticut Department of Transportation

Connecticut DOT (CTDOT) modeled three scenarios for each of its assets in the 2022 TAMP (CTDOT 2022): no funding, current funding, and preferred funding.

The no funding scenario is used to demonstrate how an asset is expected to deteriorate without future investment. This is a hypothetical situation that CTDOT does not expect to occur but is considered useful as a point of comparison and a communication tool. The current funding scenario is based on expected funding in the future. The preferred funding scenario represents the amount of investment required to meet CTDOT condition goals. This funding level is unique to each asset and is also the amount of investment required to close all condition gaps for assets in the TAMP.

As in TxDOT's TAMP, CTDOT's results are depicted in line charts, with each line representing asset condition over time in a particular funding scenario. By developing scenarios that link investment levels, asset conditions, and performance goals, CTDOT is preparing for the future and mitigating the risk that financial uncertainty will disrupt asset management performance.

Strategy 3 Examples: Ensuring a Steady Investment in Asset Preservation

Steady investment in asset preservation can be a simple way for agencies to reduce the potential impacts of revenue fluctuations. As financial risks are typically unpredictable and uncontrollable, it can be difficult to plan for potential reductions in revenue or increases in costs that may affect asset management programming. Having a dedicated preservation program can be the best mitigation against such risks, as it helps keep assets in a state of good repair at the lowest cost possible. Not only that, but a dedicated investment may be easier to protect from budget cuts in times of economic turmoil.

Florida DOT

Section 334.046 of the Florida Statutes (Florida Senate 2018) specifies several principles that must be considered as the Florida DOT plans and develops a safe statewide transportation system. The highest among these principles is preserving the existing transportation infrastructure.

The State statutes provide quantitative performance measures that must be met concerning pavement, bridge, and maintenance conditions. The Florida DOT must preserve the State's transportation infrastructure to these specific standards.

These state of good repair (SOGR) priorities are integral to Florida DOT's mission, business processes, and planning documents. As articulated in the TAMP, the Florida DOT uses these measures to assess how well the infrastructure is functioning, provide decision support, assess its project delivery, determine how well it is meeting its customers' needs, and show accountability to its transportation stakeholders (Florida DOT 2015, 2019). Armed with these principles, funding is prioritized first to ensure pavement, bridge, and maintenance targets are met before any capacity projects are undertaken. This mitigates the risk of asset conditions being negatively affected by reduced revenues or increased costs.

Strategy 4 Examples: Exploring Alternate Revenue Sources

While State DOTs may have little control over costs or existing revenues, exploring alternate revenue sources can help mitigate the risk of declining funding. This strategy may not be considered by all State DOTs, but they should at least be aware of alternatives that could be used.

Pennsylvania DOT

Pennsylvania DOT (PennDOT) faces short- and long-term funding challenges. Several factors are causing lower revenues and higher costs, including declining gas tax revenue due to fuel efficiency, adoption of electric vehicles (EVs), and reduced vehicle miles traveled (VMT); increasing emergency repair costs due to more frequent extreme weather events; and inflation increasing construction costs while reducing the purchasing power of the Federal gas tax (PennDOT 2022, Pennsylvania TROC 2021). This means PennDOT may have insufficient

resources to perform asset management, causing declining asset conditions, expensive work postponements, and delays to the traveling public and freight.

As part of the *PennDOT Pathways* (PennDOT 2023) program established to identify, implement, and explore alternate sources of funding, a Planning and Environmental Linkages (PEL) study was conducted (PennDOT 2021). This study identified tolling and managed lanes as viable near-term strategies, with congestion pricing suggested as a medium-term strategy. Also in 2021, the Pennsylvania governor established a Transportation Revenue Options Commission (TROC) to develop a strategic proposal to close the funding gap. The commission included stakeholders from the public and private sectors and was chaired by the PennDOT Secretary. The TROC issued a report (Pennsylvania TROC 2021) built on the recommendations from the PEL study and suggested tolling, road user charges, redirection of funding, fees, and taxes as key alternative revenue sources. The TROC report outlined how the five alternative revenue sources would close the multibillion dollar revenue gap faced by PennDOT.

The results of the PEL study and the TROC report were summarized in the PennDOT TAMP (PennDOT 2022) and underlined the narrative that strengthening financial vulnerability is a key risk mitigation activity for PennDOT. The TROC report was referenced in the chapter on risk management, while both the TROC report and the PEL study were featured in the TAMP financial plan. While uncertain future funding and costs remain a risk, PennDOT's approach to identifying and implementing alternate revenue sources provides a potential path to financial stability.

SECTION 5: KEYS TO SUCCESS

Through a TAMP's financial risks consideration, State DOTs determine the adequacy of planned revenue to address asset needs and evaluate uncertainties that could impact the plan negatively or positively. The risk analysis formalizes the consideration of those uncertainties. It also provides a communication tool that enables agencies to highlight trends that influence how transportation assets are managed. Financial risks, such as uncertainty in revenue forecasts and material costs, are largely influenced by political decisions, market forces, and other factors outside of a State DOT's control. Communicating trends and illustrating the impact these risks could have on asset and system performance demonstrate to stakeholders that the State DOT is managing the transportation system credibly and is a good steward of the public funds entrusted to it.

Based on the information presented and drawing on lessons learned from successful State DOT implementations, this section identifies several factors that State DOTs could implement to help ensure success in managing financial risks.

Framing Risks Effectively

- Define the risk so the potential event is clear and potential negative impacts are understood if they are not managed.
- Clarify who is responsible for managing the risk and expectations for frequency.
- Identify who needs to be informed of changes in trends or an increased likelihood of an event occurring, including individuals who may be responsible for updating the TAMP and its investment strategies.

Quantifying Potential Impacts

- Establish effective mitigation strategies to address each potential impact.
- Estimate the impact in meaningful terms, such as impacts on the budget, ability to achieve performance and safety objectives, sustainability, and reputation.
- Communicate impacts with stakeholders in ways that resonate.

Developing Effective Risk Management Strategies

- Monitor trends in financial indicators to alert decisionmakers to the potential need to revise investment strategies.
- Consider alternative sources of revenue or strategies that enable revenue inconsistencies to be addressed.
- Evaluate different scenarios to better understand the impacts of potential events.
- Build confidence in the ability of analysis models to reflect actual conditions.
- Prioritize changes that will take place if either a revenue shortfall or windfall occurs and communicate the priorities to those individuals planning and programming projects.
- Consider establishing a pool of projects that can be implemented quickly if additional funding becomes available.

Staying the Course

- Recognize the importance of regular, ongoing investment in preserving long-lived assets as a strategy to avoid a backlog of unfunded needs.
- Analyze the long-term impacts of financial risks on long-lived assets.
- Build support among elected officials and other stakeholders for sustainable funding levels for transportation assets.
- Use analysis results to build credibility as good stewards of public funds.

Communicating Regularly

- Recognize the TAMP's contribution as a communication tool to inform decisionmakers of the consequences of their choices.
- Inform decisionmakers of changes in trends that may impact investment plans.
- Educate decisionmakers on the potential consequences associated with inadequate funding for transportation assets.
- Communicate how funds are being used and what changes will be made if financial risk events occur.

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APPENDIX A: RESOURCES

Resources

- TAM Portal.
- Enterprise Risk Management Portal.
- State Transportation Asset Management Plans.

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