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TRANSPORTATION PERFORMANCE MANAGEMENT

Sponsored by AASHTO CPBM and the TPM Pooled Fund with support from FHWA

Welcome to the Fall 2021 edition of the Transportation Performance Management (TPM) Newsletter, sponsored by the American Association of State Highway and Transportation Officials (AASHTO) Committee on Performance-Based Management (CPBM) in collaboration with the TPM Pooled Fund. The TPM Pooled Fund is supported by AASHTO and the Federal Highway Administration (FHWA).

CONTENTS

Managing Risk in the 21st Century

Transportation agency risks come in many forms, from the risks of project cost overruns to accelerated deterioration of assets on the NHS. The FHWA defines risk and risk management as:

- Risk: *The positive or negative effects of uncertainty or variability upon agency objectives.*
- Risk Management: *The processes and framework for managing potential risks, including identifying, analyzing, evaluating, and addressing the risks to assets and system performance*[i].

AASHTO describes risk management as a complement to performance management and asset management disciplines in support of agency strategic objectives, as shown in Figure 1[ii].

Figure 1. *Enterprise Risk Management Complements Performance and Asset Management Source: AASHTO, 2016.*

The Moving Ahead for Progress in the 21st Century Act (MAP-21) and the Fixing America's Surface Transportation Act (FAST) require state DOTs to implement a risk-based asset management plan in support of their performance-based decision-making. A risk-based Transportation Asset Management Plan (TAMP) is intended to identify, assess, evaluate and prioritize risks and describe how they will be mitigated. Given the federal requirements and the fast pace of change within organizations, transportation agencies are becoming increasingly proactive in managing risks at the organizational, programmatic, project and functional levels within their organizations.

[i] 23 CFR Part 515.5

[ii] American Association of State Highway and Transportation Officials. (2016) AASHTO Guide for Enterprise Risk Management. Retrieved from https://store.transportation.org/Item/PublicationDetail?ID=2706

Welcome from the AASHTO CPBM Risk Management Subcommittee Chair

Jean Wallace, PE, PMP

Assistant Division Director Modal Planning & Program Management Division

Minnesota Department of Transportation

Chair, AASHTO CPBM Risk Management Subcommittee

On behalf of the AASHTO CPBM and the TPM Pooled Fund, I invite you to take a few minutes to read and examine the *TPM Newsletter* with a focus this quarter on **Risk Management**. The articles, resources, and events featured in this edition provide perspectives on managing agency risks, implementing enterprise risk management, and highlighting valuable capacity-building resources for agencies. The feature article on the development of a risk management strategic plan and research roadmap, and the article highlighting a risk and resilience roadmap provide the latest in National Cooperative Highway Research Program (NCHRP) research on this topic.

Risk management feels timelier than ever before. We continue to face many uncertainties that affect our work in transportation, potentially both positive and negative in consequence. Risk management is an effective tool at the project, program, and enterprise levels that offers a framework to identify risks, assess their potential outcomes and prioritization, and identify potential strategies to manage them. While the requirement for risk-based asset management plans formalized risk management within many State DOTs, a risk management framework can also be used in transportation agencies to allocate scarce resources, better inform decision-making processes, enhance system resilience, and to ensure performance objectives can be met.

Joint AASHTO CPBM/TPM Pooled Fund Quarterly Meeting

Feature Topic:
Performance Management - Moving to New Measures
Matt Hardy will provide an IIJA update

Dec. 2, 2021, 2 PM – 4 PM EST

Register:
https://bit.ly/30xnwh2

The content featured in the *Fall 2021 TPM Newsletter* includes updates on the latest training and events, new resources, and tools under development by the TPM Pooled Fund.

I hope you enjoy the articles in this *Fall 2021 TPM Newsletter*. We look forward to your feedback on this edition and the topics you would like to see featured in upcoming quarters. Feel free to contact Matt Hardy at mhardy@aashto.org with any feedback or suggestions for future articles.

Weaving Risk Management into Your Agency, Every Day

Mara Campbell
Jacobs Engineering Group

Risk management is key to many decisions made in our everyday lives, through the people with which we surround ourselves and the activities we do. This has recently become even more apparent with the COVID-19 pandemic interrupting normal life and forcing a closer look at what's going on around us and how we are factoring potential outcomes and their impact on us. While many of us might have just started noticing some form of risk management we (hopefully) routinely perform, transportation agencies have spent years developing ways to consider risk by using both qualitative and quantitative assessments. Investments into agency assets carry risk to operational performance, asset condition, safety, politics and regional economics. Agencies performing these assessments are working to meet performance-based planning and risk-based asset management requirements that allow them to consider the underlying risks and ultimately achieve their defined goals.

Ongoing research into these efforts is the focus of NCHRP Project 20-123(04) – Development of a Risk Management Strategic Plan and a Research Roadmap. This research collaboration includes AASHTO, Transportation Research Board (TRB), FHWA, and agency practitioners, with the goal of providing a comprehensive strategic approach and action plan for risk management implementation. This effort also includes a risk management research roadmap to identify and showcase future research needs.

Our research team began their journey by identifying existing activities and research, including various strategic plans and roadmaps within the AASHTO CPBM and completed on-going research on the topic of Risk Management. In addition, the team completed a robust literature review of published research in the area of Risk Management which included peer-reviewed research, the Transportation Research Information Database (TRID), the Transportation Asset Management portal (TAM), and FHWA publications. From that review, a gap assessment was created. The gap assessment identified key knowledge gaps, and those gaps have served as an introduction to what is evidentially missing from previously completed in-depth research on risk management practices. The key knowledge gaps include:

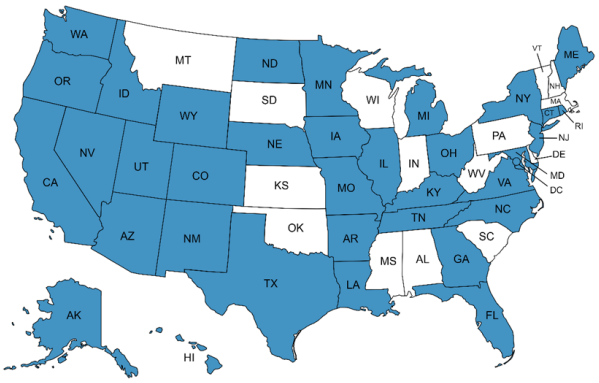
- **Measurement and Quantification of Risk**- Critical to most decision-making activities.
- **Data and Tools-** Managing overwhelming amounts of data by using tools and skills, as well as incorporating systems for integrating and sharing data.
- **Integration with Existing Processes**- Many methods are already in place and agencies have to adjust to the varying processes available.
- **Coordination and Communication**- Structures and protocols need to be in place to plan for disruptions and ensure coordination between agencies. This includes robust communication mediums.
- **Retrospective Evaluation**- Learning from past events can help improve and shape future actions.
- **Workforce Capacity and Modernization**- The workforce of the future is constantly evolving, and agencies need to be able to address and handle the risk and opportunity that comes with it.

Using the key knowledge gaps, the research team developed a collection of potential risk management research products and research statements. These were then validated with agencies across the nation through a series of engagement events and workshops. Through these engagement activities, coupled with the gaps discovered from the literature review, key takeaways were discovered that should be included in future research problem statements such as:

- Develop standard guidance and methods to calculate/estimate risk of different transportation business practices;
- Improve system monitoring, knowledge sharing, and how model policies and standards are established;
- Incorporate risk management into operation, design, maintenance, and construction practice;
- Develop a risk assessment framework for transportation infrastructure and local coordination;
- Include data from past events, climate change stressors, and development of guidance for emerging cyber, financial, and enterprise risks;
- Develop tools, models, and exercises, as well as staff training and investing in resilient infrastructure; and
- Develop models for risk prioritization, decision making, and program investment.

The research team knew it was important to hear from actual practitioners. It was critical to obtain practitioner input to identify if they felt the gaps were relevant and/or if there were gaps missing that they felt should be included. A practitioner survey was conducted with participants from TRB committees, AASHTO, FHWA, and well-published risk experts within transportation and other sectors. The twenty-question survey aimed at gaining a high-level, national overview of the scale and application of risk management concepts from the Risk Management practitioner community and responses were received from 32 states, as well as the District of Columbia. From the survey the team discovered practitioners felt the three greatest challenges in risk management were lack of staff resources, unclear/siloed business processes, and lack of established performance goals/ measures. They also identified what they felt the three largest knowledge gaps were: workforce support, communication, and processes.

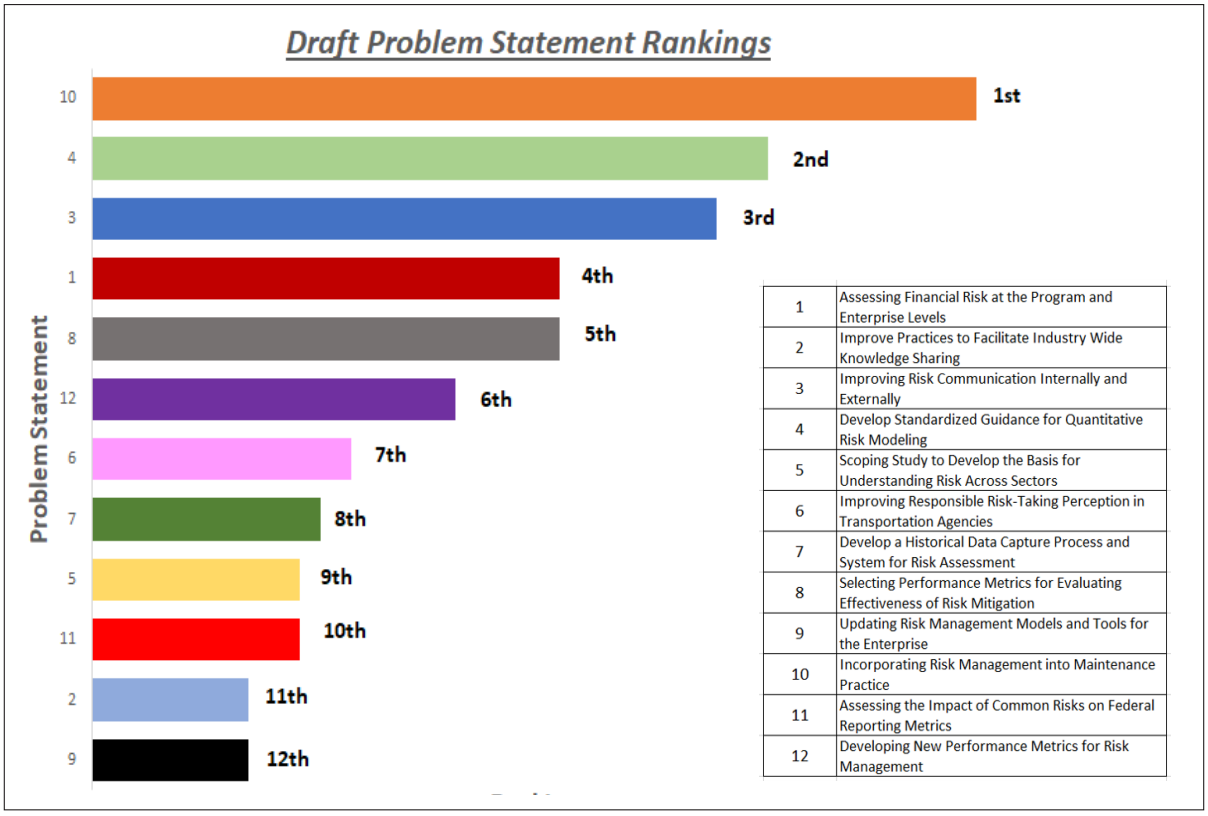
Figure 2 *Risk Management Practitioner Survey Participant States*



Using this information, the research team held webinars with both the AASHTO CPBM Sub-Committee on Risk Management and the AASHTO Committee on Transportation System Security and Resilience (CTSSR) Steering Committee to do a deep dive into the findings thus far. These webinars helped to determine and cement the important issues and concerns related to risk management. It became clear the research needed to highlight benefits of taking risks through productive failure and experimentation, defining organizational risk tolerance, supporting organizational risk culture with executive leadership, prioritizing risks (e.g., safety, climate resiliency), and developing new tools, standards, and performance metrics. By focusing on these issues, practitioners were confident a comprehensive Risk Management Strategic Approach and Action Plan could be created and it would be useful and applicable for transportation professionals.

To support the webinar discussion, virtual Engagement Events with the two AASHTO committees were held during their monthly meetings. The goal was to obtain their input and feedback on the issues and concerns that were elevated from the practitioner survey and "deep dive" webinars. Draft research problem statements (RPS), developed from the list of potential risk management research products and research, were also provided to the committees for evaluation and input. Committee members ranked the RPS on their perceived ability to advance a knowledge gap identified in the research and its potential value to the general risk management discussion.

Figure 3 *Draft RPS from Engagement Activities*



1	Assessing Financial Risk at the Program and Enterprise Levels
2	Improve Practices to Facilitate Industry Wide Knowledge Sharing
3	Improving Risk Communication Internally and Externally
4	Develop Standardized Guidance for Quantitative Risk Modeling
5	Scoping Study to Develop the Basis for Understanding Risk Across Sectors
6	Improving Responsible Risk-Taking Perception in Transportation Agencies
7	Develop a Historical Data Capture Process and System for Risk Assessment
8	Selecting Performance Metrics for Evaluating Effectiveness of Risk Mitigation
9	Updating Risk Management Models and Tools for the Enterprise
10	Incorporating Risk Management into Maintenance Practice
11	Assessing the Impact of Common Risks on Federal Reporting Metrics
12	Developing New Performance Metrics for Risk Management

The responses indicated a theme around the most critical RPS being improving staff understanding of what risk is, and better considering its impacts within an agency. Specifically, the top-ranked RPS were assessing financial risk at the program and enterprise levels, improving practices to facilitate industry wide knowledge sharing, and improving risk communication internally and externally.

Having a decent understanding of what these practitioners wanted to see and needed, the research team held a virtual workshop to develop a concrete, prioritized list of goals, objectives, and strategies that would create a Risk Management Strategic Approach and Action Plan for AASHTO, that would be supported and endorsed by TRB and FHWA. Members from AASHTO's Subcommittee on Risk Management, Committee on Transportation System Security and Resilience, and Committee on Planning, FHWA leads, and TRB Committee Chairs were involved in the discussion. From this workshop, participants created six goals, with strategies identified to help achieve those goals. In addition, action plans detailing who, what, when, and how the strategies could be accomplished were developed. The goals are to:

- Enhance understanding and implementation by creating enterprise, program, and project level communications and methods, developing an executive outreach program, and creating a market plan.
- Provide and share new analytical tools and leverage existing ones by developing a one-stop shop for risk management resources and a means to incubate new tools.
- Develop a business case for why this is important and model the private sector by reviewing existing research, conducting case studies, and measuring benefits.
- Establish a scalable framework that can be applied appropriately in different agencies.
- Help DOTs develop a risk management culture by breaking down silos and integrating risk management through guidance and peer exchanges.
- Broaden risk management to include all users and affected parties of our system and the broader community.

To reinforce the research problems elevated from the engagement events, the research team conducted a Risk Management Research Roadmap Workshop to finalize a list of research concepts and ensure all identified gaps had been addressed. The RPS were incorporated into a five-year, sequential and prioritized list of research needs, taking into consideration the prerequisites needed for each.

WHATS NEXT? The results from all of these efforts will be compiled to create a comprehensive Risk Management Strategic Approach and Action Plan and a Risk Management Research Roadmap. The plan and roadmap will then soon be available to assist transportation professionals better integrate risk management into their agency and produce resources and methods to better understand risk and its roles in an agency.

Mara Campbell
Global Technologist Transportation Performance & Policy
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Communicating and Consulting with Stakeholders is Essential to Managing Risk

Daniel Fodera

Corporate Performance and Risk Management Officer in the Federal Highway Administration Office of Infrastructure

As stewards of the nation's highway systems, we are charged with preserving our transportation assets for future generations. We have to ask ourselves "what could happen, how could it affect our system, and what could we do about it?" These are fundamental questions. Our process for answering them is straightforward and uncomplicated. We use risk management.

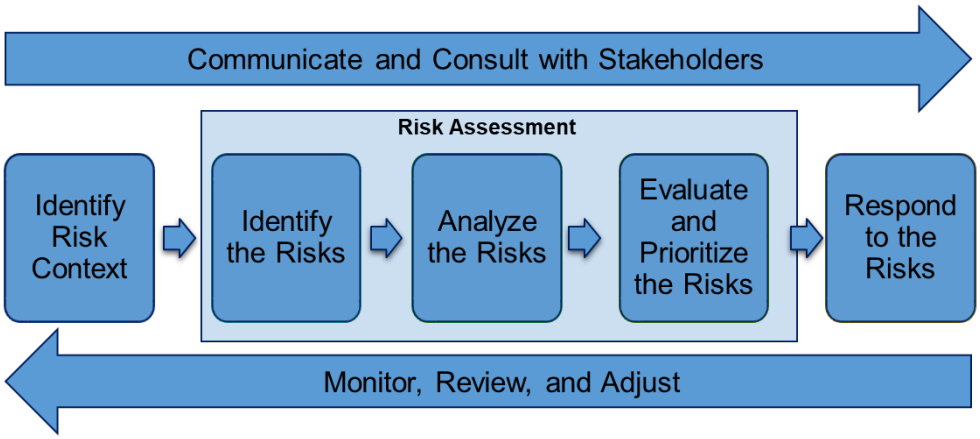
Risk management has been a part of FHWA's approach to stewardship and oversight for two decades. The objective of the FHWA risk management process is to establish a consistent approach to identify, prioritize, and respond to program area risk.

Federal highway asset management regulations define risk as *the positive or negative effects of uncertainty or variability upon agency objectives*.[iii] This is consistent with the international standard definition of risk, the "*effect of uncertainty on objectives*." The definitions share three components. **Objectives** means that risk exists only relative to desired outcomes, outputs, or end state. This is what you trying to achieve. **Effect** refers to impact. There will be some positive or negative impact on what you are trying to achieve. **Uncertainty** means the event, condition, or trigger that may or may not happen. There may be variability, complexity, or ambiguity in play, but risk is always in the future.

If risk is about the future, then risk management allows us to communicate and consult with our stakeholders about possible futures. Communication and consultation are important activities in risk management. In FHWA, we identify stakeholders by asking, who needs to be involved, who can affect, be affected by, or perceive themselves to be affected by a decision or activity. Once stakeholders are identified, we can decide where and how communication and consultation should happen.

Communication and consultation should occur at every step of the risk management process - from establishing context to assessment, response, monitoring, and review (see Figure 4 below.) Communication means ensuring that stakeholders are informed, while consultation means that stakeholder input is asked for and considered.

Figure 4 *The 7-Step FHWA Risk Management Process*



While state and local agencies establish their own timelines for their approach to integrating risk management into planning and decision making, every FHWA office conducts a risk assessment every year as part of their business planning process. We either directly engage our stakeholders or use our knowledge of stakeholders and their needs as part of the risk assessment. We use the results of this analysis to inform decisions about what programs or projects to focus our efforts on, and where to put our resources to achieve the desired outcomes.

In FHWA, division offices have flexibility in where and how they communicate or consult with stakeholders at each step of the risk management process. Many FHWA offices emphasize stakeholder involvement early on, when program managers or specialists conduct program assessments to understand current issues, gather different perspectives, and review program performance. Understanding the operating environment and current issues informs risk identification.

[iii] 23 CFR Part 515.5

Risk identification is the next part of the process where FHWA practitioners engage and consider the perspective of stakeholders. Comprehensive risk identification - which means identifying all possible risks to your program - is challenging, but getting input from multiple sources can help. Federal, state, and local transportation agencies have different objectives and context, so some risks will be unique to that organization, but because we are all in the same business, there is considerable overlap. Even where we see the same risks, we may evaluate their impact and prioritize differently. Consulting with stakeholders helps to identify risks so they can be communicated within and across transportation organizations.

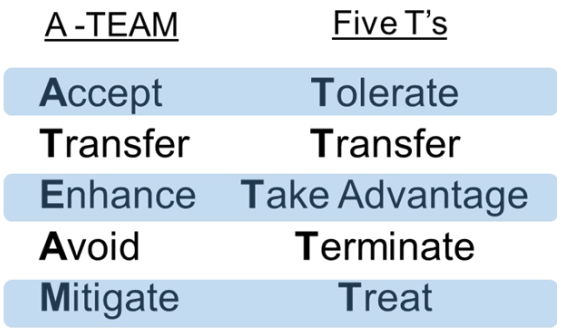
Each identified risk - that is, what could happen, how could it affect our system, programs, or projects - is communicated using a risk statement. A risk statement typically has an "If, then" structure, where an event or trigger follows "If," and impacts or effects follow "then." For example[iv], *"If there is an economic downturn and impact on fuel tax revenue then it can decrease available funding."* We also create short descriptions to communicate risks, with the example above being "*economic downturn.*" The list of risks is then put into a risk register (Figure 5) that shows the risk and the risk statement. Risks are analyzed for likelihood and the severity of potential impacts, compared, then prioritized. Responses are then developed for top risks.

Figure 5 *A Simple Risk Register*

Risk	Statement	Value	Response
Staffing and Knowledge Retention	If the agency does not implement workforce planning for required skillsets, then there may not be enough qualified employees for project delivery.	High	Mitigate – identify high risk skillsets and implement workforce planning
Economic Downturn	If there is an economic downturn and impact on fuel tax revenue then it can decrease available funding.	High	Accept – develop contingency approach for delivery with decreased funding
Lack of Organizational Alignment	If the agency is not aligned on priorities and the delivery of investment strategies, the agency may not deliver planned activities.	Low	Mitigate – communicate priorities and strategy across the organization

The risk response is what we are going to do with our limited resources. There are two common approaches to defining risk responses, A-TEAM and the Five T's (see Figure 6). Although they use different terminology, the strategies they define are similar. Regardless, deciding whether and how to accept, transfer, enhance, avoid, or mitigate threats and opportunities is another step where we make communication and consultation happen. Whether we are dealing with system risks or stewardship and oversight risk, this is another place where FHWA offices may engage with stakeholders to decide on specific activities to support risk management strategies. Depending on the risk and shared priorities, risk response may require joint or individual action on the part of FHWA or stakeholders. FHWA risk response strategies often include activities such as providing guidance, training and technical assistance, project involvement, program and process reviews.

Figure 6 *Types of Risk Response Strategies*



[iv] International Organization for Standardization. (2018). Risk Management Guidelines (ISO Standard No. 31000:2018). https://www.iso.org/iso-31000-risk-management.html

Risk responses are documented in the risk register or plan as activities so they can be communicated consistently and monitored for results. Risk registers are shared internally within FHWA to help identify trends or crosscutting issues, as well as a control to ensure that all plans reflect agency priority activities. At this stage of the risk management process, with a complete risk register or action plan, the next steps are to carry out the activities, then monitor, evaluate, and adjust.

Monitoring allows organizations to be nimble so as to effectively respond to unpredictable events and evolving conditions[v]. It is important to establish processes to track changes in risks over time and monitor actions taken to manage risks.

We monitor the action taken to manage risk at different levels of the organization[vi]. Responsibility for monitoring risk falls to those responsible for success in their part of the organization. Project managers monitor risks to project scope, schedule, cost, and quality. In FHWA, project risk, including compliance risk, informs decisions about project involvement. Program managers monitor risks across projects or program areas to ensure effectiveness, efficiency, and compliance. At the enterprise level, the senior leaders of an organization are responsible for monitoring risks to achieving the strategic goals and overall mission and ensuring that agency responses are consistent with risk appetite.

In FHWA, offices regularly check and report the status of activities that respond to top risks. The results of risk response activities are considered as part of the next planning evolution, risks are reevaluated, and the cycle continues.

It's not complicated, but preserving our highway systems for future generations requires that transportation professionals take a thoughtful, organized approach to understand and communicate what could happen, how it could affect us, and what we can do about it. The best approach is a good risk management process.

Daniel Fodera is the Corporate Performance and Risk Management Officer in the Federal Highway Administration Office of Infrastructure. He has held FHWA positions in field offices and headquarters. Prior to joining FHWA, he served in the US Navy as an airborne cryptologist, arms control inspector, National Security Agency analyst, and senior leader. Daniel is a Certified Enterprise Risk Manager, holds one US patent, has earned a Master's in Public Administration from the University of Maryland (Europe) and a Master Black Belt Certificate in Lean Six Sigma from Villanova University.

[v] https://www.tamguide.com/subsection/5-1-4-consideration-of-risk-in-resource-allocation/

[vi] American Association of State Highway and Transportation Officials. (2016) AASHTO Guide for Enterprise Risk Management. Retrieved from https://store.transportation.org/Item/PublicationDetail?ID=2706

UDOT's ERM Journey

Nathan Lee, PE
UDOT

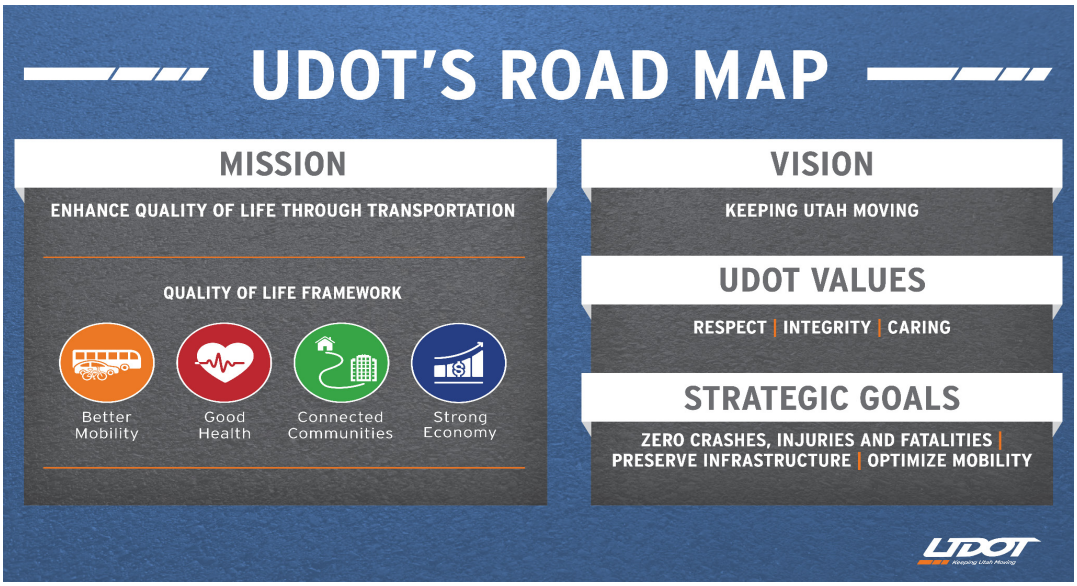
Patrick Cowley, PE
UDOT

INTRODUCTION

The Utah Department of Transportation's (UDOT) mission to "enhance quality of life through transportation" cannot succeed without intentional focus on UDOT's quality of life framework, which promotes good health, connected communities, and strong economy (see Figure 7). With these interconnected yet independent objectives, one may ask "How does enterprise risk management (ERM) complement UDOT's mission?"

ERM is a systematic process to identify risks at all levels. It helps to improve accountability, provides a cohesive structure to analyze risk threats, and monitors how such threats are addressed. Although UDOT's journey is similar to other DOT agencies, each DOT has to apply ERM to meet their business needs. This article describes how UDOT embraced ERM and how ERM will evolve to adapt to the ongoing challenges UDOT faces.

Figure 7 *UDOT's Road Map, Utah Department of Transportation*



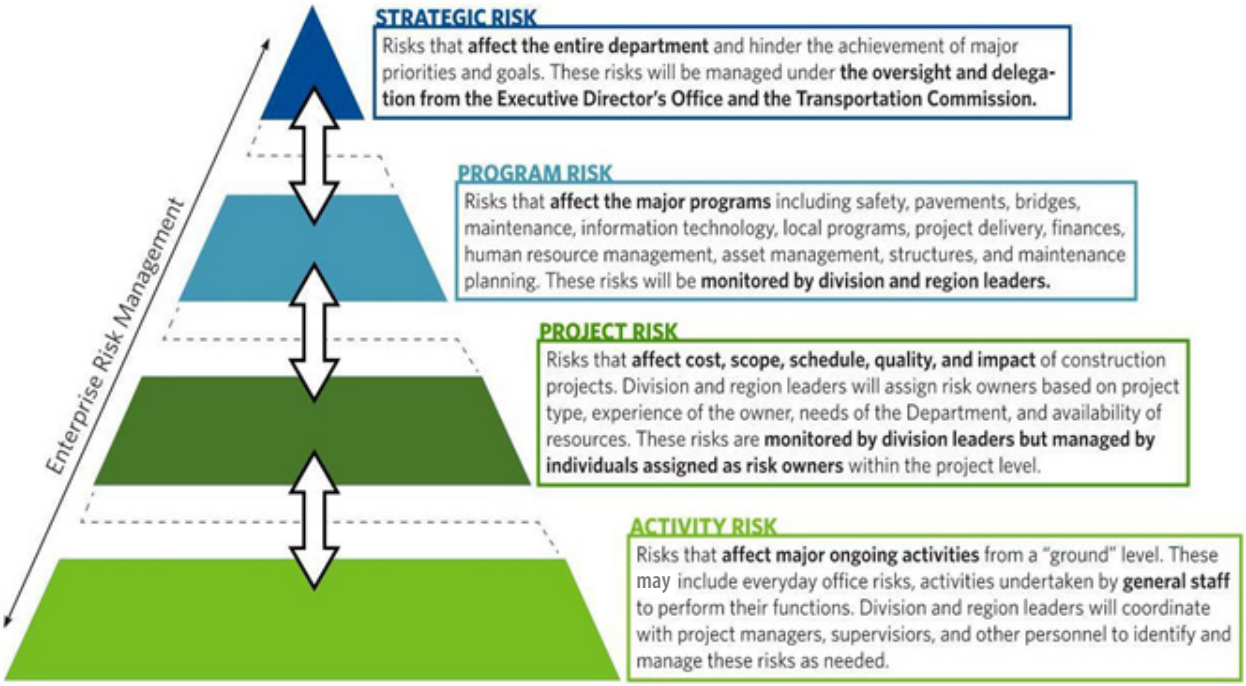
STEP ONE: DEFINING ERM

A strong ERM process begins with tone at the top. In accordance with the Treadway Commission of Sponsoring Organizations (COSO) or other risk management frameworks, an effective ERM begins with senior leaders. UDOT leaders were essential to create an in-house ERM policy. This policy describes the expectation of "All employees…. to understand the potential dangers, risks, and vulnerabilities of their respective positions."

As UDOT considered risk management as an enterprise wide affair, it was apparent that risk management impacts UDOT at all levels from frontline workers to executives. Every member of UDOT has a role to identify, mitigate, and reduce the impact from ongoing risks. Coincidently, employees will often make risk management decisions with their day-to-day efforts without realizing it. They may have to choose how to safely repair a pothole or mitigate seismic forces on a bridge. No matter the decision, UDOT employees regularly identify and mitigate risk.

This simple yet effective chart illustrates the intricacies of how one risk may impact multiple areas of UDOT. See Figure 8 on the following page for details.

Figure 8 *UDOT Enterprise Risk Model, Utah Department of Transportation*



STEP TWO: RESILIENCY AS A MEASURE OF WHAT GOOD LOOKS LIKE

Resiliency goes hand-in-hand with risk management. UDOT has to recognize risk vulnerabilities and provide mitigation strategies that improve resiliency. Applying an ERM framework allows UDOT to better assess four elements of resiliency. They are:

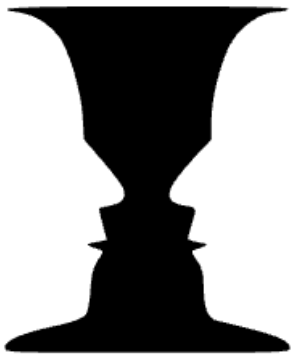
Robustness – measure of the increase in the ability of a system to withstand a given level of stress and/or demand

Redundancy – measure of the ability for substitution

Resourcefulness – measure of the capacity to mobilize resources in reaction to a disruption

Rapidity – measure of the capacity to contain or minimize losses in a timely manner

Figure 9*: Gestalt Vase*



Alan De Smet at English Wikipedia, Public domain, via Wikimedia Commons

By evaluating UDOT from the four R's of resiliency, we can identify the risk vulnerabilities that reduce resiliency.

Figure 9 illustrates the relationship between resilience and risk management. One may ask, is this a goblet? Or is it two individuals looking at each other? In either case, one can better analyze the picture with an understanding of both perspectives.

Resiliency in this case, may be defined as "what good should look like." The two faces may be defined as the understanding of the risks that shapes the goblet as it is.

STEP THREE: RECOGNIZING POTENTIAL RED TAPE

Realizing that risks impact all levels of UDOT, risks can be lost in any type of red tape. This is where UDOT continually strives to improve. ERM is teaching us that even when risks are identified, if the right communication, proper accountability, or support is not provided, key risks are often ignored or improperly addressed until they become a crisis.

STEP FOUR: START WITH DOCUMENTING SOMETHING

In 2017, UDOT began "collecting" risks from a simple template that each senior leader completed with their management team across all different divisions within UDOT. This process is annual. UDOT tinkers with this risk assessment process to improve how UDOT recognizes and addresses risks each year. Currently, the UDOT Internal Audit Division reviews, aggregates, and presents the results from the risk assessment to executive leadership and the governing transportation commission.

This process of aggregating risks into a central repository has allowed UDOT to holistically identify risks that impact multiple divisions and programs. It has allowed UDOT to make calculated decisions on funding requests and where to divert resources. Although this process continues to evolve, more work is required to increase UDOT's ability to implement an effective enterprise risk framework.

NEXT STEPS: WHAT'S NEXT FOR UDOT

1. **Training, Training, Training**
   Educating employees on what it means to have risk and how to apply the right treatment requires ongoing emphasis as each year, new risk concerns and issues arise.

2. **Enterprise Risk Manager**
   Central Expertise from an enterprise risk manager could improve oversight of the ERM process. This person can help UDOT improve coordination with different divisions and employees. They can format templates and communication so each employee speaks the same language and is better understood by others.

3. **An Enterprise Risk Committee to Prioritize Enterprise Level Risks**
   Effective risk management efforts have a higher likelihood of success when others buy into its success. Creating a committee of engineers, accountants, subject matter experts, and other general staff, enables them to participate in high level risk discussion and see the impact one particular risk may have in the organization instead of just their sphere of influence.

4. **Share Success Stories**
   How has ERM improved business? This can be hard to articulate since the benefits of ERM cannot be quantified as easily as miles of new pavement. When stakeholders see the benefits of ERM, then their likelihood of participating will increase. This will also improve the results of the ERM process. Instead of an annual requirement, it becomes a frequent exercise for leaders to assess their success.

CONCLUSION: VIVA ERM!

ERM provides the framework for us to bridge the gap between where we are and where we want to be. While wholesale changes won't need to be made, there are a number of things we can do at each risk level to enhance the effectiveness of ERM and improve UDOT's resilience. By applying principles of accountability and a system of risk elevation, we allow our employees to continue to do their good work in keeping Utah moving by enhancing quality of life through transportation.

Nathan Lee, PE
Director of Technology & Innovation
Utah Department of Transportation

Patrick Cowley., PE
Director of Transportation Performance Management
Utah Department of Transportation

A Risk and Resilience Roadmap to Better Performance-Based Asset Management

Maria Pena
AEM

Vaishali Shah
AEM

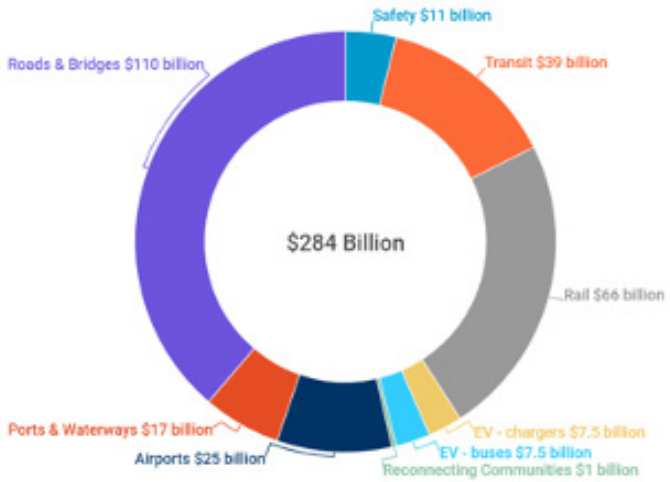
State DOTs manage billions of dollars in highway assets, ranging from bridges and pavement to Intelligent Transportation Systems (ITS) sensors. Despite the scale of these investments, however, they may not have incorporated current risk management approaches that have been proven to increase roadway capacity and reliability and also extend the impact of these budgets. Investments that mitigate risk and enhance transportation systems resiliency are critical to delivering a world-class transportation system, particularly in the face of unprecedented budgetary, workforce, and climate-change challenges.

In addition, on November 5, the U.S. House of Representatives passed the Infrastructure Investment and Jobs Act (IIJA) to be signed into law. The infrastructure legislation provides $973 billion over five years from FY 2022 through FY 2026, directing $284 billion spending toward all modes of transportation. Figure 10 shows the distribution of fund per mode.[vii]

Part of the requirements of IIJA include the establishment of a risk and system resilience assessment intergovernmental process. Based on this, "USDOT will be required to work with federal, state and local agencies to develop a process for quantifying annual risk in order to increase system resilience within the nation's surface transportation system. USDOT will be instructed to provide guidance and technical assistance to state and local agencies on the process." [viii]

Based on a growing body of insights, the NCHRP Project 23-09 team is working towards the adoption of a national quantitative risk and resilience framework and guidance that will help USDOT to meet the requirements of the recent IIJA legislation. This article provides a short background and an explanation of associated efforts.

Figure 10 *Distribution of IIJA Funding Toward Transportation by Mode*



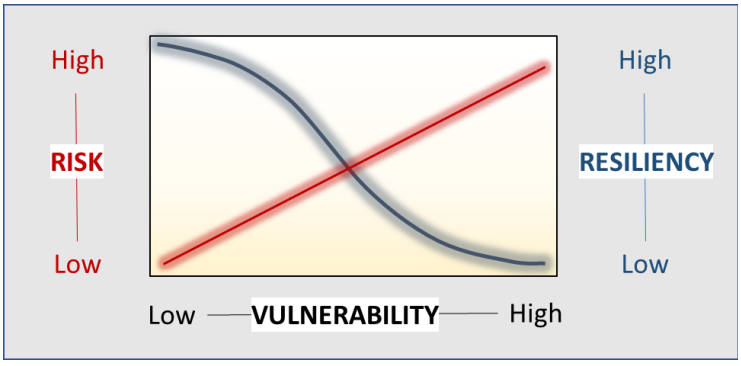
THE VALUE OF RISK MANAGEMENT

At a high level, risk management encompasses three actions: the identification of potential threats and hazards, the assessment of asset vulnerabilities from applicable threats and hazards, and the evaluation of mitigation actions to reduce the effects of threats and hazards.

By anticipating and managing risks to transportation infrastructure through these efforts, agencies reduce the likelihood of disruptions to their transportation systems. They also increase their resiliency, which is defined by FHWA as the "ability to anticipate, prepare for and adapt to changing conditions and withstand, respond to and recover rapidly from disruptions."

Reducing asset vulnerability helps reduce transportation system risk and increases resilience. The relationship between risk and resilience is inverse, as illustrated in the figure to the right.

Figure 11 *Relationship between Vulnerability, Risk and Resiliency (adapted from Department of Homeland Security)*



[vii] https://www.naco.org/resources/legislative-analysis-counties-infrastructure-investment-jobs-act

[viii] https://www.naco.org/resources/legislative-analysis-counties-infrastructure-investment-jobs-act

A second, equally critical element for promoting resiliency is separate from asset decisions and focuses on operations response. Planning for how to respond, recover and adapt to possible disruptions also plays an important role in improving resilience.

STATE OF RISK-BASED ASSET MANAGEMENT PLANNING

FHWA regulations initiated by MAP-21, require state DOTs to: "identify risks to their assets and include risk management and full-lifecycle planning in their asset management planning process" and consider future extreme weather events and climate change. In addition, Metropolitan Planning Organizations (MPOs) are required "to consider improving the resiliency and reliability of the transportation system" and "reduce the vulnerability of existing transportation infrastructure through capital investments."

Nearly all DOTs now use qualitative, judgment-based approaches to assess risks in the form of a Risk Register. Many DOTs are also beginning to focus on methods that include resiliency considerations. Unfortunately, these qualitative approaches do not provide the opportunity to conduct economic analysis of any risk mitigation or resilience improvement strategies, and consequently do not sufficiently support the investment decisions and trade-offs that every agency needs to make.

The few DOTs that have used quantitative risk and resilience processes often use different analytical frameworks. Consider the FHWA VAST framework, the FHWA Final Rule framework, and the Colorado and Utah DOT Quantitative Risk frameworks based on the Risk Analysis and Management for Critical Asset Protection (RAMCAP) Framework. Each framework has specific strengths and shortcomings. This speaks to an important underlying point: qualitative frameworks are more easily standardized and implemented, while quantitative frameworks can better inform investment decisions.

A common quantitative framework for risk and resiliency promises many improvements. It will help DOTs ensure their methods are sound and consistent with peers. A common quantitative framework will enable agencies to assess and investment needs and compare against available funding to demonstrate the business need and value for investing in specific risk and resilience strategies. A framework will also foster consistency and clarity for how to incorporate risk and resilience related performance measures as a part of transportation performance management.

DOTs would greatly benefit from a consistent, practical framework for quantitative risk and resilience assessments. However, many gaps in knowledge, skills, tools, and data stand in the way. Accordingly, the AASHTO CTSSR and Subcommittees on Risk Management and Asset Management supported NCHRP Project 23-09 to clarify the knowledge gaps and define a research roadmap to overcome these gaps.

THE ROAD FORWARD

Maria Pena, Senior Infrastructure Risk Analyst at AEM Corporation, leads the NCHRP Project 23-09 team, which also including Jacobs Engineering Group and Cambridge Systematics. The team is developing a multi-year research roadmap to clarify the necessary research needed to establish common methodologies and tools, conduct pilot tests of the methodologies and tools, and promote the adoption of the quantitative R&R framework.

The research project has thus far produced a comprehensive glossary of risk and resilience terms, a state of practice review, and a gap assessment. Based on these work products, and input from nearly 30 DOTs through workshops, the AEM research team has developed and organized three categories of research problem statements:

- Organizational development, outreach, and implementation
- Risk and resilience assessment process
- Technologies and tools to support assessments and decision-making

The research problem statements were reviewed by AASHTO and NCHRP. Their subsequent funding and implementation will ensure the formation of a risk assessment processes, methods, and tools to integrate risk management into DOT asset and performance management systems helping DOTs meet the requirements of the recent *Infrastructure Investment and Jobs Act (IIJA*) legislation..

The culmination of research along with the roadmap will ensure that agencies manage assets and make investment decisions that cost-effectively reduce risk and improve transportation system resiliency for decades to come. The final research problem statements and roadmap are scheduled for release in late summer 2022.

Maria Pena and Vaishali Shah
AEM

Featured Transportation Risk Management Research

Below is a selection of recent AASHTO and NCHRP publications related to performance, risk, and asset management. The list also includes selected, active NCHRP research projects on these topics. Project descriptions shown in italics are taken directly from the TRB web site, www.trb.org, accessed October 2021

AASHTO Guide for Enterprise Risk Management, First Edition. 2016. Washington, DC: AASHTO. https://store.transportation.org/. *This guide provides a framework to identify and manage risk for state DOTs, and to establish and manage an enterprise risk management program.*

NCHRP Synthesis Report 527: Resilience in Transportation Planning, Engineering, Management, Policy, and Administration (NCHRP Synthesis 20-05, Topic 48-13). 2018. Washington, DC: The National Academies Press. https://doi.org/10.17226/25166. *This report documents resilience efforts and how they are organized, understood, and implemented within transportation agencies' core functions and services. Core functions and services include planning, engineering, construction, maintenance, operations, and administration.*

NCHRP Report 658: Guidebook on Risk Analysis Tools and Management Practices to Control Transportation Project Costs. 2010. Washington, DC: The National Academies Press. https://doi.org/10.17226/14391. *This guidebook provides guidance to state departments of transportation for using specific, practical, and risk-related management practices and analysis tools for managing and controlling transportation project costs.*

NCHRP 02-26 [Active] Implementation of Life-Cycle Planning Analysis in a Transportation Asset Management Framework. *The objective of this research is to develop guidance coupled with one or more prototypical, analytical model(s) to support life-cycle planning and decision-making that applies life-cycle cost analysis as a component of a system-wide transportation asset management program.*

NCHRP 08-113 [Active] Integrating Effective Transportation Performance, Risk and Asset Management Practices. *The objective of this research is to provide transportation agencies with practical guidance, recommendations, and successful implementation practices for 1) Integrating performance, risk, and asset management at transportation agencies; 2) Identifying, evaluating, and selecting appropriate management frameworks; and 3) Recruiting, training, and retaining human capital to support asset management and related functions.*

NCHRP 08-118 [Active] Risk Assessment Techniques for Transportation Asset Management. *The objectives of this research project are to develop enhanced techniques to consider and evaluate asset management-related risks as part of investment decision-making practices; review effective processes to determine how existing and potential approaches can be used when integrating enterprise, network, and program level risk analysis; develop strategies and procedures for risk mitigation and response with applicable tools and tracking mechanisms for transportation agencies to improve risk assessment in existing and evolving asset management business processes; and develop implementation guidance, including practical tools and techniques for incorporating risk and uncertainty, as well as possible measures of asset resilience.*

NCHRP 08-137 [Active] Further Enhancements and Content for the AASHTO Transportation Asset Management Guide – A Focus on Implementation (TAM Guide III). *With the original project being completed in early 2020, the project panel has focused on both implementation of TAM Guide III and determining additional needs to make the TAM Guide III better based on the original literature research and review.*

NCHRP 20-123(04) [Active] Strategic Planning Session and Development of a Risk-Management Research Roadmap. *The objectives of this effort are to develop a comprehensive strategic approach and action plan to coordinate the risk management activities that AASHTO committees and councils, TRB committees, and FHWA can use to guide their future activities and to develop a long-term risk management Research Roadmap that will guide future research and development activities to be undertaken by the transportation industry in a coordinated fashion.*

NCHRP 08-118 [Active] Risk Assessment Techniques for Transportation Asset Management. *Phase I will synthesize materials on existing practice and perform a critical assessment of existing tools, approaches, performance measures, and procedures that can be used to build new or improved risk assessment tools and techniques in support of transportation asset management. Phase II will produce supporting implementation guidance and tools.*

NCHRP 23-07 [Active] Effective Methods for Setting Transportation Performance Targets. *The objective of this research is to develop and disseminate a practitioner-ready guidebook for state DOTs that is focused on methods for the target-setting component of transportation performance management. The guidebook will provide information on selecting effective methods that use both qualitative and quantitative sources to establish performance targets. The guidebook will also address how to re-evaluate targets, taking into account unforeseen changes impacting the transportation system, performance data, and performance reporting requirements.*

NCHRP 23-09 [Active] Scoping Study to Develop the Basis for a Highway Standard to Conduct an All-Hazards Risk and Resilience Analysis. *The objective of this research is to provide a scoping study for a transportation framework for all-hazards risk and resilience analysis of transportation assets. The scoping study is intended to develop a comprehensive and consistent set of risk- and resilience-related terminology for transportation agency use; and provide a research roadmap for developing a framework for a quantitative all-hazards risk and resilience analysis of transportation assets, with its associated tools, and guidance on its application.*

NCHRP 23-08 [Active] Guidelines for Incorporating Maintenance Costs into a Transportation Asset Management Plan. *The objective of this research is to develop a guide for state DOTs and other transportation agencies on incorporating maintenance costs in a risk-based TAMP.*

NCHRP 23-15 [Active] Guidance on Risks Related to Emerging and Disruptive Technologies. *The objectives of this research are to (1) develop a register of risks to state and local transportation agencies and their constituents posed by the emerging technologies of CAVs, electric vehicles, MoD/MaaS, and Advanced Air Mobility, (2) recommend approaches agencies can use to prioritize those risks, and (3) identify policies and actions to address the risks along with the potential impacts of those policies and actions.*

NCHRP 23-24 [Active] Develop Methods to Allow Agencies to Incorporate Quantitative Risk Assessment at Project and Network Level. *The project objectives are to (1) generate risk identification techniques to determine high-risk threats at project and network levels; (2) develop quantitative, repeatable approaches for assessing likelihood and consequences for these threats; and (3) develop visual, interactive characterization methods (e.g., dashboards) to reflect an agency's level of risk and the effectiveness of proposed mitigation actions.*

NCHRP 08-151 [Active] Building Risk-Management Momentum in Agencies. *The objectives of this research are to (1) Identify and evaluate potential barriers to adoption and sustained implementation of formal risk-management practices and a risk-informed culture in state DOTs; (2) Identify best practices of risk management from the private sector that can translate to state DOTs; and (3) Identify effective approaches to overcome those barriers and increase the momentum among state DOTs in adopting and sustaining the use of formal risk management.*

Save the Date

CONFERENCES

ITS America 2021: Reimagining Transportation
December 7-10, 2021, Charlotte, NC
Register: https://www.itsamericaevents.com/annual-meeting/en-us.html

2022 Transportation Research Board 101st Annual Meeting
January 9-13, 2022, Washington, D.C.
Register: https://www.trb.org/AnnualMeeting/Registration.aspx

Sustainability and Emerging Transportation Technology (SETT) Conference
March 15-18, 2022, Irvine, CA
More information: https://trb.secure-platform.com/a/page/Sustainability2022/SETTAbstractsCall

2022 AMPO Planning Tools and Training Symposium
May 16-19, 2022, Fort Lauderdale, FL
More information: https://ampo.org/news-events/ampo-planning-tools-training-symposium

2022 Conference on Scenario Planning
September 19-22, 2022
More information to come.

MEETINGS

Joint AASHTO CPBM/TPM Pooled Fund Quarterly Meeting
December 2, 2021, 2 PM – 4 PM EST
Register: https://us02web.zoom.us/meeting/register/tZIqdeCtrzosE9DYLeQq5A3oaivk2i0Cc7Fr

WEBINARS

TPM Webinar 9 – Organizational Management and Measures
November 17, 2021, 2 PM – 3:30 PM Eastern Time
Register: https://register.gotowebinar.com/register/9106293151213231374

TAM Webinar 52 – FHWA/ AASHTO TAM Webinar Series
December 15, 2021, 2 PM – 3:30 PM Eastern Time
Register: https://register.gotowebinar.com/register/2415077707691478800

EVENTS

2022 AASHTO Washington Briefing
March 1-4, 2022, Washington, D.C.
More information: https://meetings.transportation.org/event/2022-aashto-washington-briefing/

TPM REPORTING DEADLINE

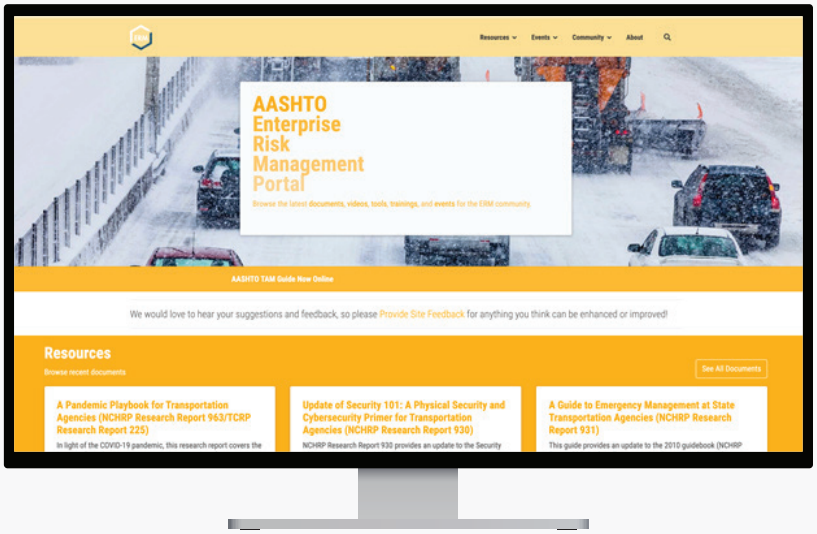
Full Performance Period Progress Report
October 1, 2022
More information: https://www.tpm-portal.com/events/full-performance-period-progress-report/

AASHTO ERM Portal

The AASHTO ERM Portal connects you to a searchable database of transportation asset management resources: documents, presentations, events, tools, and more. The portal is designed to help transportation enterprise risk management practitioners search and access relevant information from multiple sources.

https://www.erm-portal.com/

AASHTO ERM Portal



Get Involved in a CPBM Subcommittee or Work Group

Asset Management Subcommittee
Chair: Matt Haubrich, Iowa DOT
Vice-Chair: Anne-Marie McDonnell, Connecticut DOT
Membership Coordinator: Louis Feagans, Indiana DOT
AASHTO Liaison: Matt Hardy
FHWA Liaison: Steve Gaj
Meetings: Monthly joint meetings with TRB AJE30, second Wednesday of each month, 1 PM – 2:30 PM EST
https://www.tam-portal.com/event/ to sign up for meetings

Organizational Management Subcommittee
Co-Chairs: Deanna Belden, Minnesota DOT, Charlie Purcell, Iowa DOT
Secretary: Stacey Houston, Iowa DOT
AASHTO Liaison: Matt Hardy
FHWA Liaison: Nelson Hoffman
Meetings: Monthly joint meetings with TRB AJE15 Workforce Development and Organizational Excellence Committee, third Tuesday of each month from 12 PM – 1:30 PM EST
https://www.tpm-portal.com/community/cpbm/om/

Risk Management Subcommittee
Chair: Jean Wallace, Minnesota DOT
Vice-Chair: Nathan Lee, Utah DOT
AASHTO Liaison: Matt Hardy
FHWA Liaison: Daniel Fodera
Meetings: Second Monday of even-numbered months, 1-2 PM EST
https://www.tpm-portal.com/community/cpbm/rm/

Joint Subcommittee on System Mobility and Emerging Technologies (SMET)
Chair: Daniela Bremmer, Washington State DOT
Vice-Chair: Jay Styles, Virginia DOT
AASHTO CTSO – Staff Liaison: Patrick Zelinski
AASHTO Liaison: Matt Hardy
FHWA Liaison: Rich Taylor
Meetings: Third Tuesday of even-numbered month, 2:30 PM – 3:30 PM EST
https://www.tpm-portal.com/community/cpbm/sm/

Policy and Rulemaking Work Group
Co-Chairs: Paul Degges, Tennessee DOT
https://www.tpm-portal.com/community/cpbm/policy/
Second Tuesday, 1 PM – 2 PM EST

Research Work Group
Chair: William Johnson
Matt Hardy, AASHTO CPBM – Staff Liaison
FHWA Liaison: Nelson Hoffman
Meetings: Monthly meetings, second Friday, 10 AM – 11 AM EST
https://www.tpm-portal.com/community/cpbm/research/

Professional Development
Chair: Ryan Huff, Nebraska DOT
Matt Hardy, AASHTO CPBM – Staff Liaison
FHWA Liaison: Chris Change
Meetings: As needed
https://www.tpm-portal.com/community/cpbm/pd/

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