AASHTO COMMITTEE ON PERFORMANCE-BASED MANAGEMENT

Research Roadmap

2026

Risk Management

Contents

RM CPBM Scope

Risk Management (RM)

Definition. Risk Management is the formal and systematic effort to control uncertainty and variability on an organization's strategic objectives by managing risks at all levels of the organization. It encompasses strategic, program, project, and activity-level risks.

Focus. The RM subcommittee facilitates the implementation of risk management approaches in STAs - equipping them with tools and strategies to leverage opportunities and address potential threats.

RM Research Themes and Needs

Risk Management (RM)

A. **Characterizing Threats, Assessing Risks, and Communicating About Risk and Resilience.** Research to advance practices for identifying, characterizing and communicating about potential threats to transportation agencies' ability to achieve performance objectives.

B. **Advancing Risk Analytics.** Research to advance analytical methods for risk analysis and prediction to enable informed decision making and proactive risk mitigation.

C. **Integrating Agency Risk Management Processes.** Research to improve and integrate risk management processes and practices at the strategic, program, project, and activity levels.

Risk Management (RM) Future Research Needs

Research Need	RRM Track	Collaborators
A. Characterizing Threats, Assessing Risks, and Communicating About Risk and Resilience Research to advance practices for identifying, characterizing, and communicating about potential threats to transportation agencies' ability to achieve performance objectives		
A1. Develop and improve application of **performance metrics for risk** management • Identify new performance metrics for risk management • Provide guidance for developing and using performance metrics to evaluate effectiveness of risk mitigation • *Build on Results of NCHRP 23-35 - A Guide for Program-Level Risk Management Performance Metrics (2026)* • *Build on results of NCHRP 20-123(04) Support for AASHTO Committees and Councils. Development of a Risk Management Strategic Plan and a Research Roadmap (2022)*	DM	AASHTO CPBM-EPA TRB AQB13
A2. Develop or extend current risk management frameworks to consider information technology and information dissemination-related risks for STAs • Characterize potential threats for STAs related to implementation of AI technologies • Characterize emerging cybersecurity risks for STAs related to quantum computing • Characterize potential threats for STAs related to dissemination and use of misinformation	PM	AASHTO CPBM-EPA TRB AQB13
A3. Advance application of **program-level risk performance metrics** and assessment methods • Develop techniques for assessing the impact of common risks on federal reporting metrics • Advance techniques for assessing financial risk at the program level • Develop guides showing how to manage risks to core programs, such as pavements, bridges, safety, information technology, and workforce development • *Build on Results of NCHRP 23-35 - A Guide for Program-Level Risk Management Performance Metrics (2026)*	PM	AASHTO CPBM-TAM TRB AQB13

Research Need	RRM Track	Collaborators
A4. Improve assessment of **systemic risks** impacting transportation system resilience • Provide guidance on approaches to system-level risk assessment that considers interdependencies between transportation and other critical systems (e.g., energy, telecommunications) • Provide guidance on how to analyze risk across the transportation system as a whole, and how to aggregate risk across assets and the network • Consider a scoping study to develop a basis for further work • *Build on results of NCHRP 20-123(04) Support for AASHTO Committees and Councils. Development of a Risk Management Strategic Plan and a Research Roadmap (2022)*	PM	AASHTO CTSSR TRB ACF18, AQB13
A5. Improve **data and tools** for transportation agency risk assessment • Assess the state of the practice in risk assessment, with an emphasis on data sources and tools • Identify gaps in data sources and tools • Identify strategies for data improvement supporting risk assessment – including new/improved historical data capture processes • Develop new tools for transportation agency risk assessment • Identify models for risk data sharing within and across agencies • *Build on results of NCHRP 20-123(04) Support for AASHTO Committees and Councils. Development of a Risk Management Strategic Plan and a Research Roadmap (2022)*	OC	TRB AQB13
A6. Develop guidance and models for **communicating** about risk and resilience • Consider both internal (within an agency) and external communication • Cover localized, program-level, and systemic risks • Include visualization techniques that illustrate uncertainty and the impacts of multiple scenarios • *Build on results of NCHRP 20-127 - Business Case and Communications Strategies for State DOT Resilience Efforts (2023)*	PM	AASHTO CTSSR TRB ACF18, AQB13
A7. Develop approaches to formulate and communicate about **risk tolerance and acceptance** parameters • Develop guidance on establishing risk tolerance and thresholds • Identify metrics for risk tolerance (e.g. Value at Risk) and cover how to apply them • *Build on results of NCHRP 20-123(04) Support for AASHTO Committees and Councils. Development of a Risk Management Strategic Plan and a Research Roadmap (2022)*	DM	TRB AQB13

Research Need	RRM Track	Collaborators
A8. Build **workforce capacity** for effective risk management and resilience planning • Create a toolkit for CEOs to help them quickly get up to speed with risk management and resilience planning – show how tools such as risk management and strategic planning help CEOs shape what the organization of the future should look like • Develop guidance and models for encouraging responsible risk-taking behavior in agencies • *Build on results of NCHRP 08-151 - Risk Management at State DOTs: Building Momentum and Sustaining the Practice (2024)*	OC	AASHTO CTSSR TRB ACF18, AQB13
A9. Share **best practices** in risk management • Provide opportunities for agencies to share their experiences • Disseminate findings of risk management research	SE	TRB AQB13
B. Advancing Risk Analytics Research to advance analytical methods for risk analysis and prediction to enable informed decision making and proactive risk mitigation		
B1. Advance **risk measurement and forecasting** techniques • Provide standardized guidance for quantitative risk modeling • Advance application of flooding predictive modeling techniques • *Build on results of NCHRP 20-59(53)A Guide to Flood Forecasting for Transportation Resilience (2024)*	PM	AASHTO CTSSR TRB ACF18, AQB13
B2. Develop new **predictive models** for traveler response to unplanned events or incidents • Explore use of AI including Large Language Models and Big Data Sets	DM	TRB AED12, AEP14
B3. Develop methodologies and models to estimate the **benefits and costs of resilience investments** • Conduct retrospective analyses to quantify benefits, costs and ROI of historical investments • Provide documented examples of how planned and actual investments mitigate risks • *Build on results of NCHRP 20-44(02) NCHRP Implementation Support Program. Implementation of the AASHTO Guide for Enterprise Risk Management (2021)*	DM	AASHTO CTSSR TRB ACF18, AQB13

Research Need	RRM Track	Collaborators
C. Integrating Agency Risk Management Processes Research to improve and integrate risk management processes and practices at the strategic, program, project, and activity levels		
C1. Provide quick response research on the **implications of federal policy changes** on agency approaches to risk management • Assess implications of shift from "all hazards" to "risk-informed" approach to resilience (EO 14239, March 2025) • Identify agency responses to new federal policy related to resilience	DM	AASHTO CPBM-P&R TRB AQB13
C2. Provide guidance for **integrating risk management with transportation planning** processes • Address long-range planning, corridor planning, metropolitan planning, TIP/STIP development • Consider financial risks • Integrate lessons learned from the pandemic about responding to budget uncertainties • *Build on results of NCHRP 08-129 Incorporating Resilience Concepts and Strategies in Transportation Planning (2022)* • *Build on results of NCHRP 23-32 – Transportation Asset Risk and Resilience (2026)*	DM	AASHTO COP TRB AQB13, AEP11
C3. Provide guidance for **integrating risk management with performance** target setting, monitoring, and adjustment processes • *Build on the results of NCHRP 23-37 Integrating Performance Management, Risk Management, and Process Improvement: A Guide (2027)* • *Build on results of NCHRP 23-32 – Transportation Asset Risk and Resilience (2026)* • *Build on results of NCHRP 20-127 - Incorporating Resilience Concepts and Strategies in Transportation Planning (2022)*	DM	AASHTO CBPM-Cross Cutting TRB AQB13

Research Need	RRM Track	Collaborators
C4. Provide guidance for **integrating risk management with roadway engineering**, design, and management practices • Address potential impacts of CAVs on design and placement of traffic and safety assets • Address potential impacts of growing competition for curb space to meet needs of EVs (charging stations), and various mobility options (ride hailing, bike shares, scooters, etc.) • *Build on results of NCHRP 23-32 – Transportation Asset Risk and Resilience (2026)* • *Build on results of NCHRP 23-15 – Guidance on Risks Related to Emerging and Disruptive Transportation Technologies (2023)*	DM	AASHTO COD, CTE TRB AQB13, ACF17
C5. Provide guidance for **integrating risk management with transportation system management and operations** practices • *Build on results of NCHRP 23-32 – Transportation Asset Risk and Resilience (2026)*	DM	AASHTO CTSO TRB AQB13
C6. Provide guidance that illustrates and reinforces a **holistic approach** to enterprise risk management • Consider updates to the AASHTO Enterprise Risk Management Guide • Illustrate how risk-based decisions can be made and then how they flow through the agency to interact with other decision-making processes, and show how the risk analyses in various functions tie together: How do agencies create an umbrella where risks to assets, employees, and projects are linked in a cohesive and coherent way • Identify approaches and examples of how risk management fits into an agency's structure or how risk management supports the day-today decision making within agencies • *Build on results of NCHRP 08-151 - Risk Management at State DOTs: Building Momentum and Sustaining the Practice (2024)* • *Build on results of NCHRP 08-129 Incorporating Resilience Concepts and Strategies in Transportation Planning (2022)* • *Build on results of NCHRP 20-44(02) NCHRP Implementation Support Program. Implementation of the AASHTO Guide for Enterprise Risk Management (2021)*	DM	TRB AQB13

Research Need	RRM Track	Collaborators
C7. Advance risk assessment techniques for **TAM** • Address project and network-level risks • Establish and advance implementation of standard methodologies for TAM quantitative risk and resilience assessment to meet federal requirements • *Build on results of NCHRP 23-32 Transportation Asset Risk and Resilience (2026)* • *Build on results of NCHRP 08-118- Risk Assessment Techniques for Transportation Asset Management (2021)*	PM	AASHTO CPBM-TAM

RM Draft Problem Statements

CPBM RM RRM Research Problem Statement

4. **Integrating Information and Technology Risks into State DOT Decision Making**
5. **A Toolkit for Implementing Risk Management in State DOTs**
6. **A CEO Guide to Risk and Resilience Planning in State DOTs**
7. **Methods to Evaluate the Benefits and Costs of Transportation Resilience Investments**

4. Integrating Information and Technology Risks into State DOT Decision Making

PROBLEM STATEMENT TITLE

Integrating Information and Technology Risks into State DOT Decision Making

KEYWORDS / TERMS

- Information technology risk
- Cybersecurity
- Digital infrastructure
- Risk management
- Performance-based management
- Transportation asset management

RESEARCH OBJECTIVE

The objective of this research is to develop practical, implementation-ready guidance to help state DOTs identify, assess, and integrate information and technology-related risks into agency decision making, including planning, asset management, operations, and investment prioritization. The research will focus on risks associated with information technology (IT) systems, data integrity, digital infrastructure, artificial intelligence (AI), and information dissemination, and how these risks can be incorporated into existing performance-based and risk-based decision frameworks.

Expected products include:

(1) a practitioner-oriented guide describing common categories of information and technology risks relevant to state DOTs;
(2) a framework for assessing and prioritizing these risks alongside traditional asset, financial, and operational risks;
(3) example applications illustrating how technology risks can be integrated into planning, programming, asset management, and performance monitoring processes; and
(4) implementation guidance describing roles, responsibilities, and governance considerations.

Major research tasks are expected to include:

(a) review of existing risk management, cybersecurity, and digital infrastructure guidance relevant to transportation agencies;
(b) assessment of current state DOT practices for managing information and technology risks;
(c) development of a scalable risk integration framework aligned with DOT decision processes;
(d) validation through practitioner engagement; and
(e) preparation of implementation-ready guidance and examples.

URGENCY AND POTENTIAL BENEFITS

State DOTs are increasingly dependent on digital technologies, data systems, connected infrastructure, and advanced analytics to deliver transportation services and manage assets. At the same time, agencies face growing exposure to cybersecurity threats, data integrity risks, system failures, AI-related uncertainties, and misinformation. These risks can disrupt operations, undermine performance outcomes, and erode public trust if not systematically addressed.

This research is important to a majority of state DOTs because information and technology risks increasingly influence agency performance, yet are often managed separately from core planning and investment decisions. Benefits include improved resilience of digital and physical infrastructure, more informed investment decisions, reduced vulnerability to disruptions, clearer accountability, and stronger integration between enterprise risk management and performance-based management. Without this research, agencies are likely to continue addressing technology risks in silos, limiting their ability to proactively manage emerging threats.

BACKGROUND INFORMATION AND NEED FOR RESEARCH

Transportation agencies have made significant progress in adopting enterprise risk management (ERM), performance management, and asset management practices. Concurrently, DOTs are expanding use of digital delivery, intelligent transportation systems, connected and automated vehicle infrastructure, cloud-based data platforms, and AI-enabled tools. These trends create new categories of risk that extend beyond traditional asset and programmatic risks.

While many DOTs have cybersecurity or IT risk programs, these efforts are often operationally focused and not well integrated into agency-wide decision making. Existing frameworks provide limited guidance on how to systematically consider information and technology risks when setting performance targets, prioritizing investments, or evaluating tradeoffs. Targeted research is needed to bridge this gap and support integrated, risk-informed decision making.

LITERATURE SEARCH SUMMARY

A review of relevant literature indicates growing attention to enterprise risk management, cybersecurity, and digital infrastructure risks within transportation agencies, but limited guidance on integrating information and technology risks into core DOT decision-making processes.

Guidance such as the **AASHTO Guide for Enterprise Risk Management** and related FHWA materials emphasize the importance of managing risks at the strategic and program levels. However, these resources focus primarily on organizational, financial, and project delivery risks and provide limited direction on incorporating information technology, data, and digital system risks into performance-based decision making.

Several NCHRP studies have advanced understanding of transportation agency risk management. **NCHRP 08-151 (Risk Management at State DOTs: Building Momentum and Sustaining the Practice)** documents progress and challenges in implementing ERM but notes variability in how agencies address non-traditional risks. More recent efforts, such as **NCHRP 23-35 (A Guide for Program-Level Risk Management Performance Metrics)**, highlight the need for performance-oriented risk metrics but do not focus specifically on information and technology risks.

Research addressing emerging and disruptive technologies—including **NCHRP 23-15 (Guidance on Risks Related to Emerging and Disruptive Transportation Technologies)** and **NCHRP 08-127 (Impact of New Disruptive Technologies on the Performance of DOTs)**—identifies significant risks associated with connected systems, automation, and digital dependence. These studies characterize risks but stop short of providing frameworks for integrating them into routine planning, asset management, and investment decisions.

Federal guidance on cybersecurity and critical infrastructure protection emphasizes operational safeguards and compliance but does not address how technology risks should be evaluated alongside asset condition, safety, or financial risks in transportation decision making. Overall, the literature indicates that while information and technology risks are increasingly recognized, there is no consolidated, implementation-ready resource focused on integrating these risks into state DOT performance-based and risk-based decision processes. This proposed research addresses that gap by synthesizing existing work and translating it into practical, agency-focused guidance.

LINK TO 2021–2026 AASHTO STRATEGIC PLAN

This research supports the AASHTO Strategic Plan by strengthening organizational resilience, improving data-driven decision making, and helping agencies manage emerging risks associated with technology and information systems in support of safe, reliable, and sustainable transportation systems.

IMPLEMENTATION CONSIDERATIONS AND SUPPORTERS

State DOTs can implement the research results by integrating the guidance into existing enterprise risk management, performance management, asset management, and planning processes. Likely users include risk management, information technology, asset management, planning, and executive leadership staff.

Implementation can be supported through AASHTO committee activities (CPBM, RM, OE), FHWA technical assistance, peer exchanges, and targeted workshops. Supporting products such as case studies, templates, and training materials would facilitate adoption across agencies with varying levels of digital maturity.

RECOMMENDED RESEARCH FUNDING AND RESEARCH PERIOD:

[To be completed]

PROBLEM STATEMENT AUTHOR(S):

[To be completed]

POTENTIAL PANEL MEMBERS:

[To be completed]

PERSON SUBMITTING THE PROBLEM STATEMENT:

[To be completed]

5. A Toolkit for Implementing Risk Management in State DOTs

PROBLEM STATEMENT TITLE

A Toolkit for Implementing Risk Management in State DOTs

KEYWORDS / TERMS

- Enterprise risk management
- Risk-based decision making
- Performance management
- Transportation asset management
- Organizational resilience
- State DOT governance

RESEARCH OBJECTIVE

The objective of this research is to develop a practical, implementation-ready toolkit to help state DOTs systematically implement and sustain risk management practices across agency functions and decision-making processes. The research will focus on translating existing enterprise risk management (ERM) concepts and guidance into actionable tools, templates, and workflows that support integration of risk management into planning, programming, asset management, operations, and performance management.

Expected products include:

(1) a modular risk management implementation toolkit tailored to state DOT contexts;
(2) practical tools such as risk registers, mitigation strategies, prioritization matrices, performance-linked risk metrics, and monitoring approaches;
(3) guidance on roles, governance structures, and organizational integration; and
(4) example applications illustrating phased implementation approaches for agencies at different levels of risk management maturity.

Major research tasks are expected to include:

(a) review of existing ERM guidance and DOT practices;
(b) identification of common implementation barriers and success factors;
(c) development of scalable tools aligned with DOT decision processes;
(d) validation through practitioner engagement and case examples; and
(e) preparation of implementation-ready guidance and supporting materials.

URGENCY AND POTENTIAL BENEFITS

State DOTs face increasing uncertainty related to funding, weather impacts, workforce transitions, technology dependence, and public expectations. While many agencies recognize the value of risk management, implementation remains uneven and often limited to isolated functions or compliance-driven exercises.

This research is important to a majority of state DOTs because effective risk management supports proactive decision making, improves resilience, and strengthens alignment between strategic objectives and day-to-day actions. Benefits include improved prioritization of investments, better anticipation of disruptions, clearer communication of risk to leadership, and stronger integration between performance management and organizational decision making. Without this research, agencies are likely to continue struggling to operationalize risk management in a sustained and consistent manner.

BACKGROUND INFORMATION AND NEED FOR RESEARCH

Over the past decade, AASHTO, FHWA, and NCHRP have advanced awareness of risk management as a core management discipline for transportation agencies. Many state DOTs have initiated ERM programs or conducted risk assessments, often in response to leadership interest or external disruptions.

However, experience indicates that agencies frequently lack practical tools and guidance for embedding risk management into routine decision making. Existing resources emphasize concepts and frameworks but provide limited direction on how to implement risk management in ways that are scalable, repeatable, and aligned with DOT business processes. Targeted research is needed to bridge this gap and support sustained, agency-wide implementation.

LITERATURE SEARCH SUMMARY

A review of relevant literature indicates substantial research on enterprise risk management (ERM) concepts and the importance of risk-informed decision making in transportation agencies, but comparatively limited guidance on practical implementation tailored to state DOT contexts.

Resources such as the **AASHTO Guide for Enterprise Risk Management** establish principles, terminology, and high-level frameworks for ERM in transportation agencies. Similarly, FHWA guidance and peer exchange materials emphasize the value of risk management for improving resilience and performance. While these resources articulate why risk management is important, they provide limited, implementation-ready tools for integrating risk management into everyday DOT decision processes.

Several NCHRP studies have examined risk management practices at state DOTs. **NCHRP 08-151 (Risk Management at State DOTs: Building Momentum and Sustaining the Practice)** documents progress, challenges, and variability in ERM implementation across agencies, noting difficulties in sustaining momentum beyond initial adoption. **NCHRP 23-35 (A Guide for Program-Level Risk Management Performance Metrics)** advances the use of performance-oriented risk metrics but does not provide broader implementation tools or organizational integration strategies.

Research integrating risk management with other management disciplines further highlights implementation gaps. **NCHRP 23-37 (Integrating Performance Management, Risk Management, and Process Improvement: A Guide)** emphasizes the importance of alignment across management practices but focuses on conceptual integration rather than hands-on implementation support. Similarly, resilience-focused research underscores the need for risk-informed planning but does not address enterprise-wide adoption challenges.

Overall, the literature indicates that while state DOTs increasingly recognize the value of risk management, they lack a consolidated, practical toolkit to guide implementation across organizational units and decision contexts. This proposed research builds on existing ERM guidance and NCHRP findings by translating established concepts into actionable tools, templates, and workflows that enable sustained, agency-wide risk management implementation.

LINK TO 2021–2026 AASHTO STRATEGIC PLAN

This research supports the AASHTO Strategic Plan by strengthening organizational resilience, advancing data-driven and risk-informed decision making, and enhancing agencies' ability to adapt to uncertainty while delivering safe, reliable, and efficient transportation systems.

IMPLEMENTATION CONSIDERATIONS AND SUPPORTERS

State DOTs can implement the research results by incorporating the toolkit into existing ERM, performance management, planning, and asset management processes. Likely users include executive leadership, risk management coordinators, planning and programming staff, and asset management professionals.

Implementation can be supported through AASHTO committee activities (CPBM, RM, OE), FHWA technical assistance, peer exchanges, and targeted workshops. Modular tools and phased adoption guidance would enable agencies with varying levels of maturity to apply the toolkit effectively.

RECOMMENDED RESEARCH FUNDING AND RESEARCH PERIOD:

[To be completed]

PROBLEM STATEMENT AUTHOR(S):

[To be completed]

POTENTIAL PANEL MEMBERS:

[To be completed]

PERSON SUBMITTING THE PROBLEM STATEMENT:

[To be completed]

6. A CEO Guide to Risk and Resilience Planning in State DOTs

PROBLEM STATEMENT TITLE

A CEO Guide to Risk and Resilience Planning in State DOTs

KEYWORDS / TERMS

- Executive leadership
- Risk and resilience planning
- Enterprise risk management
- Organizational resilience
- Performance-based management
- State DOT governance

RESEARCH OBJECTIVE

The objective of this research is to develop a concise, practical guide tailored specifically for state DOT chief executive officers (CEOs) and executive leadership teams to support effective risk and resilience planning. The research will translate existing risk management and resilience concepts into executive-level guidance that helps leaders understand key risk exposures, set risk tolerance, align organizational priorities, and integrate risk and resilience considerations into strategic decision making.

Expected products include:

(1) an executive-oriented guide focused on the CEO role in risk and resilience planning;
(2) tools to support executive-level risk framing, prioritization, and oversight;
(3) examples illustrating how CEOs can use risk and resilience insights to guide strategic planning, investment decisions, and organizational change; and
(4) implementation guidance describing how the guide can be used within existing governance, performance management, and leadership processes.

Major research tasks are expected to include:

(a) review of existing ERM and resilience guidance relevant to executive leadership;
(b) assessment of CEO perspectives and information needs related to risk and resilience;
(c) development of executive-focused tools and frameworks;
(d) validation through engagement with current and former DOT CEOs; and
(e) preparation of an implementation-ready guide and supporting materials.

URGENCY AND POTENTIAL BENEFITS

State DOT CEOs face growing uncertainty related to funding volatility, workforce transitions, technology dependence, weather impacts, and public expectations. While many agencies have risk management and resilience initiatives, CEOs often lack concise, actionable guidance tailored to their role in setting direction, establishing risk tolerance, and ensuring organizational alignment.

This research is important to a majority of state DOTs because executive leadership is a critical success factor for effective risk and resilience planning. Benefits include improved strategic alignment, clearer prioritization of risks, stronger integration between resilience and performance objectives, and enhanced organizational preparedness. Without this research, CEOs may continue to rely on fragmented or overly technical information, limiting their ability to proactively lead risk-informed and resilient organizations.

BACKGROUND INFORMATION AND NEED FOR RESEARCH

Risk management and resilience planning have become increasingly prominent in transportation due to system interdependencies, extreme weather, and reliance on digital technologies. AASHTO, FHWA, and NCHRP have produced extensive guidance on enterprise risk management, asset risk, and resilience planning.

However, most existing resources are written for technical staff or program managers and do not directly address the needs of executive leadership. CEOs play a unique role in setting priorities, shaping organizational culture, and making tradeoffs under uncertainty. Targeted research is needed to provide CEO-level guidance that connects risk and resilience concepts to strategic leadership and governance responsibilities.

LITERATURE SEARCH SUMMARY

A review of relevant literature indicates significant progress in defining risk management and resilience concepts for transportation agencies, but limited focus on executive-level guidance tailored to state DOT CEOs.

Resources such as the **AASHTO Guide for Enterprise Risk Management** establish principles and frameworks for managing risk across transportation agencies. Similarly, FHWA guidance and resilience-focused research emphasize the importance of leadership commitment to managing risk and building resilience. While these resources highlight the role of leadership, they are largely oriented toward organizational processes rather than the specific decision-making needs of CEOs.

Several NCHRP studies have explored risk management implementation and leadership considerations. **NCHRP 08-151 (Risk Management at State DOTs: Building Momentum and Sustaining the Practice)** identifies executive sponsorship as a critical success factor but notes that many CEOs lack clear tools for engaging with risk management beyond high-level endorsement. **NCHRP 20-127 (Business Case and Communications Strategies for State DOT Resilience Efforts)** highlights the importance of executive communication in advancing resilience initiatives but does not provide structured guidance for CEO decision making.

Resilience-focused research, including the currently active **NCHRP 23-32 (Transportation Asset Risk and Resilience)** and completed **NCHRP 08-129 (Incorporating Resilience Concepts and Strategies in Transportation Planning)**, provides technical methods for assessing risk and resilience but is not designed for executive audiences. Similarly, **NCHRP 23-37 (Integrating Performance Management, Risk Management, and Process Improvement: A Guide)** emphasizes integration across management disciplines but remains focused on organizational processes rather than executive leadership practices.

Across the literature, CEOs are consistently identified as key drivers of successful risk and resilience programs, yet existing guidance does not translate technical findings into executive-level tools, questions, and decision frameworks. This proposed research addresses that gap by synthesizing existing ERM and resilience research and translating it into a concise, actionable guide tailored to the strategic leadership responsibilities of state DOT CEOs.

LINK TO 2021–2026 AASHTO STRATEGIC PLAN

This research supports the AASHTO Strategic Plan by strengthening leadership effectiveness, improving organizational resilience, and enabling data-driven, risk-informed decision making that advances safety, reliability, and sustainability.

IMPLEMENTATION CONSIDERATIONS AND SUPPORTERS

State DOTs can implement the research results by incorporating the guide into executive onboarding, strategic planning, performance reviews, and leadership development programs. Primary users include DOT CEOs, deputy secretaries, and executive leadership teams.

Implementation can be supported through AASHTO leadership forums, FHWA executive peer exchanges, and CEO roundtables. Supporting products such as executive briefings, case examples, and facilitated workshops would enhance adoption and sustained use.

RECOMMENDED RESEARCH FUNDING AND RESEARCH PERIOD:

[To be completed]

PROBLEM STATEMENT AUTHOR(S):

[To be completed]

POTENTIAL PANEL MEMBERS:

[To be completed]

PERSON SUBMITTING THE PROBLEM STATEMENT:

[To be completed]

7. Methods to Evaluate the Benefits and Costs of Transportation Resilience Investments

PROBLEM STATEMENT TITLE

Methods to Evaluate the Benefits and Costs of Transportation Resilience Investments

KEYWORDS / TERMS

- Transportation resilience
- Benefit–cost analysis
- Risk-based investment
- Performance-based management
- State DOT decision making

RESEARCH OBJECTIVE

The objective of this research is to develop practical, implementable methods for evaluating the benefits and costs of transportation resilience investments to support state DOT decision making. The research will focus on approaches that allow agencies to quantify, compare, and communicate the value of resilience investments across asset classes, hazard types, and investment scales, while accounting for uncertainty and limited data.

Expected products include:

(1) a practitioner-oriented guide describing recommended methods for estimating resilience benefits and costs;
(2) frameworks for incorporating risk, uncertainty, and avoided losses into benefit–cost and tradeoff analyses;
(3) example applications demonstrating use of the methods for different asset types and resilience strategies; and
(4) implementation guidance describing how the methods can be integrated into planning, programming, asset management, and performance management processes.

Major research tasks are expected to include:

(a) review of existing resilience evaluation and benefit–cost methodologies;
(b) assessment of state DOT practices and data limitations;
(c) development of scalable, decision-relevant evaluation approaches;
(d) testing of methods using illustrative case examples; and
(e) preparation of implementation-ready guidance and supporting materials.

URGENCY AND POTENTIAL BENEFITS

State DOTs are increasingly investing in resilience to address weather impacts, extreme weather, and system disruptions. However, agencies often lack consistent, defensible methods to evaluate the benefits and costs of resilience investments relative to other priorities. As a result, resilience projects may be difficult to justify, compare, or prioritize within constrained funding environments.

This research is important to a majority of state DOTs because credible evaluation methods are essential for integrating resilience into performance-based decision making. Benefits include improved investment prioritization, clearer articulation of resilience value, stronger justification for funding, and enhanced transparency. Without this research, agencies are likely to continue relying on ad hoc or qualitative assessments, limiting their ability to make informed, risk-based resilience investments.

BACKGROUND INFORMATION AND NEED FOR RESEARCH

Transportation resilience has emerged as a critical policy and investment focus due to increasing disruption frequency, extreme weather, and interdependencies with other systems. Federal programs and guidance encourage resilience planning, yet state DOTs face challenges translating resilience concepts into investment decisions.

While traditional benefit–cost analysis is well established for capacity and safety projects, resilience investments often involve avoided losses, reduced recovery time, and risk reduction benefits that are difficult to quantify. Existing methods vary widely and are not consistently applied across agencies. Targeted research is needed to provide practical, standardized approaches that support defensible and repeatable evaluation of resilience investments.

LITERATURE SEARCH SUMMARY

A review of relevant literature indicates growing research on transportation resilience, risk assessment, and extreme weather, but limited implementation-ready guidance for evaluating the benefits and costs of resilience investments in state DOT decision contexts.

Federal guidance such as **FHWA's Vulnerability Assessment and Adaptation Framework** and resilience planning resources emphasize identifying risks and vulnerabilities but provide limited direction on quantifying economic benefits of resilience investments. Similarly, resilience-focused NCHRP research, including the currently active **NCHRP 23-32 (Transportation Asset Risk and Resilience)**, focuses on methods for assessing risk and vulnerability but is not focused on providing standardized approaches for evaluating investment benefits and costs.

Several studies have explored resilience performance measurement. **NCHRP 23-26 (Measuring Impacts and Performance of State DOT Resilience Efforts)** and **NCHRP 25-78 (Implementing Effective Community Resilience Performance Management)** highlight the importance of measuring recovery, reliability, and system impacts following disruptions. However, these efforts focus primarily on performance measurement rather than economic evaluation of investment alternatives.

Research addressing benefit–cost analysis and economic evaluation, including **NCHRP 20-44(02) (Implementation of the AASHTO Guide for Enterprise Risk Management)** and **NCHRP 23-35 (A Guide for Program-Level Risk Management Performance Metrics)**, emphasizes incorporating risk into decision making but does not offer detailed, practical methods for valuing avoided losses, reduced downtime, or resilience co-benefits.

More recent studies, such as **NCHRP 23-15 (Guidance on Risks Related to Emerging and Disruptive Transportation Technologies)**, underscore the growing complexity of risk and uncertainty affecting transportation investments. International and academic literature offers advanced probabilistic and economic models, but these approaches are often data-intensive and difficult for DOTs to apply consistently.

Overall, the literature indicates that while state DOTs recognize the importance of resilience investments, they lack accessible, standardized methods to evaluate benefits and costs in ways that support practical decision making. This proposed research builds on existing resilience, risk, and performance research by translating concepts into implementable evaluation methods tailored to state DOT planning and programming contexts.

LINK TO 2021–2026 AASHTO STRATEGIC PLAN

This research supports the AASHTO Strategic Plan by strengthening resilience, improving data-driven and risk-informed investment decisions, and enabling agencies to deliver safe, reliable, and sustainable transportation systems.

IMPLEMENTATION CONSIDERATIONS AND SUPPORTERS

State DOTs can implement the research results by integrating the methods into existing planning, programming, asset management, and performance management processes. Likely users include planning, asset management, resilience, and finance staff.

Implementation can be supported through AASHTO committee activities (CPBM, RM, CTSSR), FHWA technical assistance, peer exchanges, and training workshops. Case examples and templates would facilitate adoption across agencies with varying data and analytical capacity.

RECOMMENDED RESEARCH FUNDING AND RESEARCH PERIOD:

[To be completed]

PROBLEM STATEMENT AUTHOR(S):

[To be completed]

POTENTIAL PANEL MEMBERS:

[To be completed]

PERSON SUBMITTING THE PROBLEM STATEMENT:

[To be completed]

Appendix: Research Projects Related to RM Scope

Projects are listed in reverse chronological order by end date. End years for pending projects were estimated based on fiscal year and duration.

Project	CPBM Area(s)	Timing Start	End	Funding	Program	Research Question	Tags
NCHRP 23-53 Aligning Relationships Between Transportation Asset Management (TAM), Planning, and Programming	TAM, RM, EPA	Pending	2029	$400,000	NCHRP	How to integrate resilience and mobility into TAM, P&P	Mobility, Resilience
NCHRP 23-38 Incorporating Risk Management into Roadway Infrastructure Maintenance Practices	RM, TAM	Oct-24	Apr-27	$500,000	NCHRP	How to integrate risk models that include the impact of climate change into inspection, maintenance, and repair and replacement cycles	Climate Change, Maintenance
NCHRP 23-37 Integrating Performance Management, Risk Management, and Process Improvement: A Guide	RM, OE	Oct-24	Mar-27	$400,000	NCHRP	How to integrate the disciplines of performance management, risk management, and process improvement	TAM/RM/P&P Process Integration
NCHRP 23-32 Transportation Asset Risk and Resilience	RM, TAM	Nov-23	Nov-26	$3,500,000	NCHRP	How to assess risk from extreme weather, climate change and other threats/hazards to traveling public and agency assets	Resilience

Project	CPBM Area(s)	Timing Start	End	Funding	Program	Research Question	Tags
NCHRP 23-35 A Guide for Program-Level Risk Management Performance Metrics	RM	Oct-24	Oct-26	$400,000	NCHRP	How to establish and use program-level risk performance metrics and quantify the benefits of risk management	Program-Level
NCHRP 23-24 Methods to Allow Agencies to Incorporate Quantitative Risk Assessment at Project and Network Level	RM, TAM	Mar-23	Dec-25	$500,000	NCHRP	What quantitative, repeatable techniques can be used to assess the vulnerability of physical transportation assets and incorporate them into life-cycle analysis and planning efforts?	Lifecycle Analysis
NCHRP 23-09 Developing a Highway Framework to Conduct an All-Hazards Risk and Resilience Analysis	RM, TAM	Oct-25	Apr-25	$250,000	NCHRP	What research is needed to create a quantitative all-hazards risk and resilience analysis of transportation assets	Research Needs, Resilience
NCHRP 23-26 Measuring Impacts and Performance of State DOT Resilience Efforts	RM, TAM	Oct-22	Dec-24	$300,000	NCHRP	How to develop and use resilience measures for different asset classes	Resilience
NCHRP 20-59(53)A Guide to Flood Forecasting for Transportation Resilience	RM	Jun-19	Jun-24	$650,000	NCHRP	How to improve prediction of the timing and magnitude of flooding?	Risk Management, Flooding
NCHRP 08-151 Risk Management at State DOTs: Building Momentum and Sustaining the Practice	RM, OE	Jun-22	Jun-24	$350,000	NCHRP	How to how to implement and sustain the use of formal risk management at STAs?	Risk Management

Project	CPBM Area(s)	Timing Start	End	Funding	Program	Research Question	Tags
NCHRP 23-15 Guidance on Risks Related to Emerging and Disruptive Transportation Technologies	RM	Oct-21	Jun-23	$500,000	NCHRP	What risks are posed by emerging technologies of CAVs, electric vehicles, Mobility on Demand/Mobility as a Service, and Advanced Air Mobility, and how can these risks be addressed?	Emerging Technologies
NCHRP 20-127 Business Case and Communications Strategies for State DOT Resilience Efforts	RM	Dec-20	Feb-23	$349,618	NCHRP	How to explain the value of investing in resilience throughout the life cycle of planning, engineering, design, operations, construction, and maintenance activities	Resilience, Communications
NCHRP 08-129 Incorporating Resilience Concepts and Strategies in Transportation Planning	RM	Sep-20	Jul-22	$300,000	NCHRP	How can agencies incorporate resilience considerations throughout the transportation planning process?	Resilience
NCHRP 20-123(04) Support for AASHTO Committees and Councils. Development of a Risk Management Strategic Plan and a Research Roadmap	RM	Jul-20	Jan-22	$225,000	NCHRP	What research is needed to further develop the integration of risk management (RM) into transportation agencies for the future?	Research Needs

Project	CPBM Area(s)	Timing Start	End	Funding	Program	Research Question	Tags
NCHRP 08-118 Risk Assessment Techniques for Transportation Asset Management	RM, TAM	May-19	Jun-21	$600,000	NCHRP	How can transportation agencies better consider and evaluate asset management-related risks as part of investment decision-making practices, and mitigate and track these risks?	Risk Management
NCHRP 20-44(02) NCHRP Implementation Support Program. Implementation of the AASHTO Guide for Enterprise Risk Management	RM	Apr-18	Mar-21	$300,000	NCHRP Implement-ation	How can adoption and use of the AASHTO enterprise risk management guidance be facilitated?	Risk Management
Project 20-59(53) FloodCast: A Framework for Enhanced Flood Event Decision Making for Transportation Resilience	TAM, RM	Sep-14	May-18	$498,162	NCHRP	How can granular, spatially explicit weather, climate, hydrologic, and hydraulic data be integrated with transportation asset information to support STA flood response and hazard mitigation decision making?	Resilience
NCHRP 20-24(105) Research Program Design---Administration of Highway and Transportation Agencies. Launching U.S. Transportation Enterprise Risk Management Programs	RM	May-15	Jul-16	$200,000	NCHRP	What training, tools, and guidance materials do STAs need to develop and maintain effective ERM programs?	Risk Management