

NCHRP 08-36, Task 121

Successful Implementation of Enterprise Risk Management in State Transportation Agencies

Requested by:

American Association of State Highway and
Transportation Officials (AASHTO)
Standing Committee on Planning

Prepared by:

Dr. David Rose (Parsons Brinckerhoff)
Dr. Keith R. Molenaar (University of Colorado at Boulder)
Dr. Amy Javernick-Will (University of Colorado at Boulder)
Dr. Matthew Hallowell (University of Colorado at Boulder)
Christopher Senesi (Parsons Brinckerhoff)
Tim McGuire (University of Colorado at Boulder)

Parsons Brinckerhoff (PB) in conjunction with the
University of Colorado at Boulder (CU)
New York City, NY

April, 2015

The information contained in this report was prepared as part of NCHRP Project 08-36,
Task 121, National Cooperative Highway Research Program (NCHRP).
Special Note: This report IS NOT an official publication of the NCHRP, the Transportation Research
Board or the National Academies.

Acknowledgements

This study was conducted for the AASHTO Standing Committee on Planning, with funding provided through the National Cooperative Highway Research Program (NCHRP) Project 08-36, Research for the AASHTO Standing Committee on Planning. The NCHRP is supported by annual voluntary contributions from the state Departments of Transportation. Project 08-36 is intended to fund quick response studies on behalf of the Standing Committee on Planning. The report was prepared by the project team members: Dr. Keith R. Molenaar (CU), Dr. David Rose (PB), Dr. Amy Javernick-Will (CU), Dr. Matthew Hallowell (CU), Tim McGuire (CU), and Christopher Senesi (PB). The work was guided by a technical working group that included:

Daniel D'Angelo, New York State Department of Transportation
Eric Davis, Minnesota Department of Transportation
David S. Ekern, DSEkern Consult
Lawrence Ferguson, Florida Department of Transportation
Martin Kidner, Wyoming Department of Transportation
Elizabeth Robbins, Washington State Department of Transportation

The project was managed by Lori L. Sundstrom, NCHRP Senior Program Officer.

Disclaimer

The opinions and conclusions expressed or implied are those of the research agency that performed the research and are not necessarily those of the Transportation Research Board or its sponsoring agencies. This report has not been reviewed or accepted by the Transportation Research Board Executive Committee or the Governing Board of the National Research Council.

TABLE OF CONTENTS

List of Figures and Tables	vi
Abstract	vii
Executive Summary	1
Background	1
Objective.....	1
Approach	1
Findings.....	1
Chapter 1 Introduction	3
Background	3
Research Objective.....	3
Chapter 2 Research Approach.....	4
Task 1: Identify DOTs Who Are Using ERM.....	4
Task 2: Identify ERM Case Examples through Interviews	5
Task 3: Recommend Case Examples.....	5
Task 4: Conduct ERM Case Studies	5
Task 5: Prepare Case Studies and Final Report.....	6
Chapter 3 Results & Findings	7
Preliminary Survey.....	7
Case Study Results	10
California DOT (Caltrans).....	10
Massachusetts DOT (MassDOT).....	11
Missouri DOT (MoDOT).....	12
Washington State DOT (WSDOT)	13
New York State DOT (NYSDOT)	14
Summary of Findings and Emerging Best Practices.....	16
1. Origin of ERM Program	16
2. Factors Influencing ERM Implementation	17
3. Organizational Support and Structure	17
4. Processes of ERM Implemented	19
5. Changes Implemented to Improve/Strengthen ERM Program.....	21

6. Results Achieved Due to ERM Implementation	22
7. Lessons Learned and Recommendations for Other DOTs	22
Chapter 4 Conclusion and Observations	24
Key Observations.....	24
Future Research	25
References	27
Appendix A: Survey Questionnaire.....	28
Appendix B: Interview Questions.....	36
Appendix C: Examples of Risk Controls	37

LIST OF FIGURES AND TABLES

FIGURES

Figure 1: Overview of Project Approach 4
Figure 2: Map of ERM Usage 7

TABLES

Table 1: DOTs with Formal ERM and Implementation of ERM Date 8
Table 2: Drivers of ERM Implementation 8
Table 3: DOTs with ERM Guidebooks, Executives, and Risk Registers 9
Table 4: Methods of Risk Management for Agency-Level Risks 9
Table 5: Caltrans – ERM Program Characteristics 10
Table 6: MassDOT – ERM Program Characteristics 12
Table 7: MoDOT – ERM Program Characteristics 13
Table 8: WSDOT – ERM Program Characteristics 14
Table 9: NYSDOT – ERM Program Characteristics 15
Table 10: ERM Frameworks for Implementation 16
Table 11: Factors Influencing ERM Implementation 17
Table 12: Organizational Location, Roles and Responsibilities of Key Individuals in DOT ERM Efforts 18
Table 13: Agency-Level Risk Identification Processes 19
Table 14: Risk Assessment Topics and Measurement Scales of Agencies 20

ABSTRACT

This report documents and presents the results of NCHRP 8-36 Task 121: *Successful Implementation of Enterprise Risk Management in State Transportation Agencies*. The primary objectives of this project were to identify, analyze, and describe the qualities of successful implementation of enterprise risk management (ERM) programs in U.S. State Departments of Transportation (DOT). The study involved interviews of DOTs and ERM practitioners to identify state issues associated with ERM implementation and to evaluate the impact these issues have on the quality of its implementation. The results of a survey of 44 DOTs were used to select case study for detailed analysis of five agencies, which were further analyzed based on seven ERM implementation elements. The findings from the study suggest DOTs are motivated to use ERM practices because they believe it will enhance their governance and improve public confidence in the agency and are starting to receive tangible benefits from ERM programs. The research concludes that DOT ERM programs are still in their infancy and agencies realize that mature ERM programs and agency-wide risk management cultures take time to develop. The authors hope that the case studies in this report will help advance the maturity of ERM in the transportation sector.

EXECUTIVE SUMMARY

BACKGROUND

Highway agencies operate in an uncertain, complex environment that is fraught with risk (Molenaar et. al 2010) and they face unique policy, technical, and third-party risks that threaten the agencies' strategic goals. International scan tours and research into the benefits that transportation agencies in other countries have realized through ERM have provided evidence as to the value of ERM for state DOTs. The enactment of the Federal Government's Moving Ahead for Progress in the 21st Century (MAP-21) with the emphasis on risk management and the requirements for risk-based asset management has further increased the interest in the results of research into the use of ERM by transportation system owners and operators. To respond to an evolving environment of risk and to satisfy the requirements for a risk-based asset management plan mandated by (MAP-21), some State Departments of Transportation (DOTs) are developing and implementing Enterprise Risk Management (ERM) programs.

OBJECTIVE

The objectives of this study (NCHRP 08-36 Task 121) are to identify and describe qualities of successful ERM implementation in state DOTs and generate a report that presents lessons learned, factors that influenced successful implementation, and a best practices matrix.

APPROACH

The study included a preliminary survey to identify which DOT agencies are implementing ERM and the key characteristics of those programs. From here, the depth of the analysis focused on detailed case study review of five agencies executing ERM. ERM Programs at these agencies were analyzed based on seven elements, including:

- Origin of ERM Program
- Factors Influencing ERM Implementation
- Organizational Support and Structure
- Processes of ERM Implemented
- Changes Implemented to Improve/Strengthen ERM Program
- Results Achieved due to ERM Implementation
- Lessons Learned and Recommendations for other DOTs

In addition to these elements, specific risks managed by each agency's ERM program were investigated and documented. These included the processes relating to: (1) Identification of strategic risks; (2) Establishment of measures for the strategic risks; and (3) Development of controls to manage these risks.

FINDINGS

Enterprise risk management is a fairly new activity for US transportation agencies and most programs have been introduced in the past five years. The research concludes that DOT ERM programs are still in their

infancy and agencies realize that mature ERM programs and agency-wide risk management cultures take time to develop. The case studies in this report provide insights to advance the maturity of ERM in the transportation sector.

The findings from the study suggest that DOTs are:

- (1) Using national and international standards to design their programs;
- (2) Being motivated to use ERM practices because they believe that it will enhance their governance and improve public confidence in their agency;
- (3) Choosing ERM champions to support their organizational structure but not necessarily creating a separate ERM unit;
- (4) Implementing standard practices for risk identification, assessment and control; and
- (5) Receiving tangible benefits from ERM programs but have not applied rigorous benefits realization and benefits management programs to their ERM implementation efforts as of the writing of this report.

CHAPTER 1 INTRODUCTION

BACKGROUND

Leaders of state departments of transportation (DOTs) manage a multitude of human, technological, political, technical, and natural resources in an environment that is fraught with uncertainty. DOTs face unique sociopolitical and technical risks such as data integrity, right-of-way acquisition and jurisdictional collaboration that make ERM critical to the efficient use of public resources. Berry and Phillips (1998, p. 53) define ERM as, “the consistent application of techniques to manage the uncertainties surrounding the achievement of an organization’s objectives.” ERM allows common risks that have often been managed at the project level or, in an ad hoc manner by senior managers, to be more efficiently and consistently managed across the enterprise.

The application of ERM in transportation agencies, as exemplified by the experience of VicRoads in Australia and other international transportation agencies (FHWA 2012), provides the opportunity to systematically avoid and mitigate risk through changing policies and business procedures. ERM facilitates the inclusion of risk management into financial analyses, asset management and other primary functions at various levels of the agency. Such integration yields a positive return on investment because risks can be managed across the organization to improve business outcomes. ERM allows an agency to align its strategic objectives with its performance and asset management programs.

The enactment of MAP-21, signed into law in July of 2012, requires each state DOT to have a risk-based asset management plan in place by 2015 to preserve the condition of their assets and improve the performance of the National Highway System (FHWA 2012). A recent study, NCHRP 20-24(74), Executive Strategies for Risk Management by State Departments of Transportation, focused on the state-of-practice of ERM in state DOTs. The study found that only 39% of DOTs had a formal ERM program in 2011. Of the DOTs with a formal ERM program in place, more than 40% felt that the agency seldom or never implemented the correct ERM procedures (Hallowell et. al 2012). There is, however, growing interest in ERM among DOTs as a method to manage threats to strategic objectives and risks to programs, divisions, and asset management and to meet the objectives of MAP-21.

RESEARCH OBJECTIVE

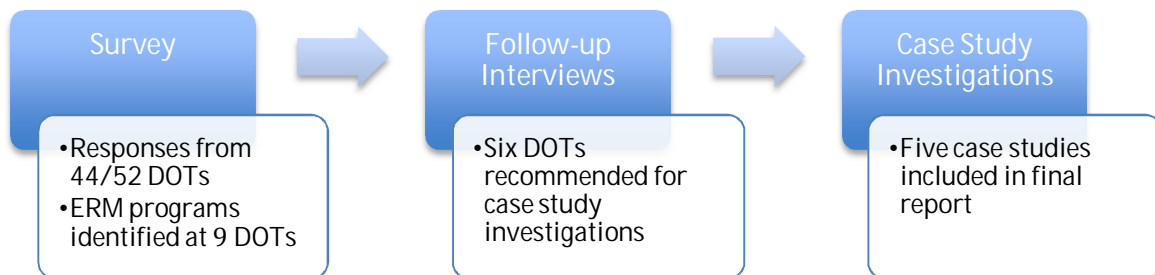
The primary objectives of this project are to identify, analyze, and describe successful ERM application and practice by highway agencies, and to document best practices to improve and implement ERM at State DOTs. The results of this research are intended to serve as reference for other DOTs as they develop and implement ERM programs to fit their agency’s risk management needs and meet the requirements set forth by the MAP-21 mandate. The report is written in a concise format to illustrate the findings of the research with examples to inform and educate the readers on ERM, while also supporting the business case for implementing ERM.

CHAPTER 2 RESEARCH APPROACH

To achieve the project objectives, the research team completed five tasks which included a sequence of three research steps for data collection and analysis methods. An overview of the data collection and analysis methods is provided in Figure 1.

- The first research step was administering a survey to state DOTs to identify and characterize DOTs that were using ERM. Survey questionnaire responses were received from 44 of the 52 DOTs (85% response rate). The analysis of these questionnaires found that only nine DOTs had initiated or implemented formal, organization-wide ERM programs.
- The second step involved interviewing individuals from eight DOTs whose positions were at or above the management level; many of whom were involved directly with the development and/or operation of their agency's ERM program.
- The third step involved conducting case studies. Based upon the survey and interview results, the research team recommended six DOTs to the NCHRP panel for further data collection and case study analysis. Although six case studies were conducted, one case study was ultimately excluded from the final analysis due to a lack of statewide implementation at the enterprise level. As a result, five case studies are included in the final report.

Figure 1: Overview of Project Approach



A brief summary of the activities conducted during each of the five project tasks is provided in the following sections.

TASK 1: IDENTIFY DOTs WHO ARE USING ERM

The research team developed a survey questionnaire informed by the literature from Federal Highway Administration (FHWA) publications on risk and asset management (FHWA 2012), the ISO-31000 Risk Management – Principles and Guidelines (ISO 2009), the ERM Framework from the Committee of Sponsoring Organizations of the Treadway Commission (COSO 2004), private sector ERM publications (Meulbroek 2002; Nocco and Stulz 2006), and past surveys regarding ERM usage (Aon 2010). The goal of the survey questionnaire was to identify DOTs who are using ERM to achieve their organization's strategic

goals and objectives and/or using ERM as part of their asset management and performance management approaches. The questionnaire is included in Appendix A.

The research team administered the online questionnaire using Qualtrics, which allowed for a controlled, efficient survey administration. The survey was distributed to targeted respondents from the research's team existing contact databases, via a hyperlink in an email delivered by the research team.

TASK 2: IDENTIFY ERM CASE EXAMPLES THROUGH INTERVIEWS

From the analysis of the survey responses, the research team conducted interviews with managers from eight DOTs. The interviews were focused on the risks that these DOTs manage through ERM, their perceived level of maturity with ERM and their basic ERM processes and organizational structure. The goal of the interviews was to obtain broad perspectives on the ERM risks, strategies, and lessons learned and to identify potential candidates for further study in Task 4.

Interviews were conducted in a semi-structured approach. The interviews included open-ended questions that allowed the interviewee to provide a rich description of their ERM program and processes and their perceptions on their level of maturity. From these interviews, the research team identified respondents from each DOT to take part in the detailed case studies. These included representatives from each DOT who were familiar with the ERM practices or risks and, when possible, representatives from different levels within the agency. The interview questions are included in Appendix B.

TASK 3: RECOMMEND CASE EXAMPLES

Based on the analysis of the survey and interview data from Task 1 and 2 respectively, the research team recommended candidates for detailed case studies and provided a case study outline for panel review and approval. The recommendations were presented to the panel to make an informed decision about which case studies to include in the final report. Based on input from both the NCHRP panel and the research team, a total of six (6) State DOTs were selected for in-depth case studies.

TASK 4: CONDUCT ERM CASE STUDIES

The research team conducted detailed case studies for each agency identified in Task 3. The primary unit of analysis for this task was the use of ERM to manage agency-level risks, not the program or project level. Relevant information collected from the previous tasks were collated for each selected case and combined with additional, in-depth information from interviews, the collection of supporting documentation, and, where possible, observations of ERM practices. The research team analyzed the data collected, first by employing within-case analysis and then comparing cases through cross-case analysis.

The objectives of the case studies were to obtain rich, descriptive examples of ERM within DOTs in order to analyze how ERM is implemented and identify and describe why certain agency management strategies are successful. Through the case studies, the research team was able to understand how the agencies implemented ERM by identifying common organizational processes, tools, and structures amongst sophisticated users and why those that use ERM effectively are successful. To help foster discussion, the research team focused on specific risks identified, analyzed, and managed using ERM. Through interviews

the research team aimed to understand: (1) the types of risks that are managed by ERM; (2) the types of risks that cannot be managed by ERM; (3) how the enterprise risks were identified, analyzed, and managed; and (4) the threat avoided or opportunities realized by using ERM for each particular risk.

A case study protocol was developed based upon the results obtained from the questionnaires and interviews from Tasks 1 and 2. Each research objective was mapped to the appropriate case study data collection methods, including interviews, documentation, and/or observations. Where interviews were used, questions were mapped not only to each objective but also to each interviewee to ensure appropriate representation of questions and coverage across respondents. The collection of data from multiple sources and respondents helped to address issues of construct validity and maintaining this protocol ensured data reliability.

The interviews, where permissible, were recorded, transcribed, and imported into qualitative analysis software, QSR NVivo. This software tool allowed the user to automatically and efficiently detect patterns in interview transcriptions, documentation and field notes collected and imported by the research team. The ultimate goal was to observe replication across interviewees to the point where new data is not obtained through subsequent interviews. Each case was analyzed separately and then a cross-case comparison was performed to analyze, compare and contrast cases.

It should be noted that as a result of this analysis, one case study was excluded from the final report. The Florida DOT was using project-based risk management on a statewide basis but was not yet implementing ERM on a statewide basis and this case study was therefore excluded from the final report.

TASK 5: PREPARE CASE STUDIES AND FINAL REPORT

The results of the case studies were compiled and presented in this final report. The final report documents the entire research effort and highlights key findings and recommendations and was prepared in accordance with NCHRP report preparation guidelines. The final report also contains a matrix for best practice tool application to help agencies benchmark their progress in achieving an integrated risk management culture.

CHAPTER 3 RESULTS & FINDINGS

PRELIMINARY SURVEY

The Task 1 survey was distributed to all 52 DOTs and a representative of the FHWA. Responses were received from representatives from 36 of the 52 US DOTs and the FHWA representative. Of the 36 responsive DOTs, nine reported that their agency had implemented formal ERM policies or initiatives. The DOTs reporting formal ERM policies were: California, Florida, Idaho, Massachusetts, Minnesota, Missouri, New York, Texas, and Washington. The FHWA representative indicated that ERM was formally implemented at the federal level. Their response was later used to serve as a reference with which to compare with state DOT responses. In select instances, where more than one response was received from the same transportation agency, the responses were aggregated.

Figure 2 provides a map displaying states reporting a formal ERM program, states with no formal ERM program, and states that did not respond to the survey as of December 17, 2013.

Figure 2: Map of ERM Usage

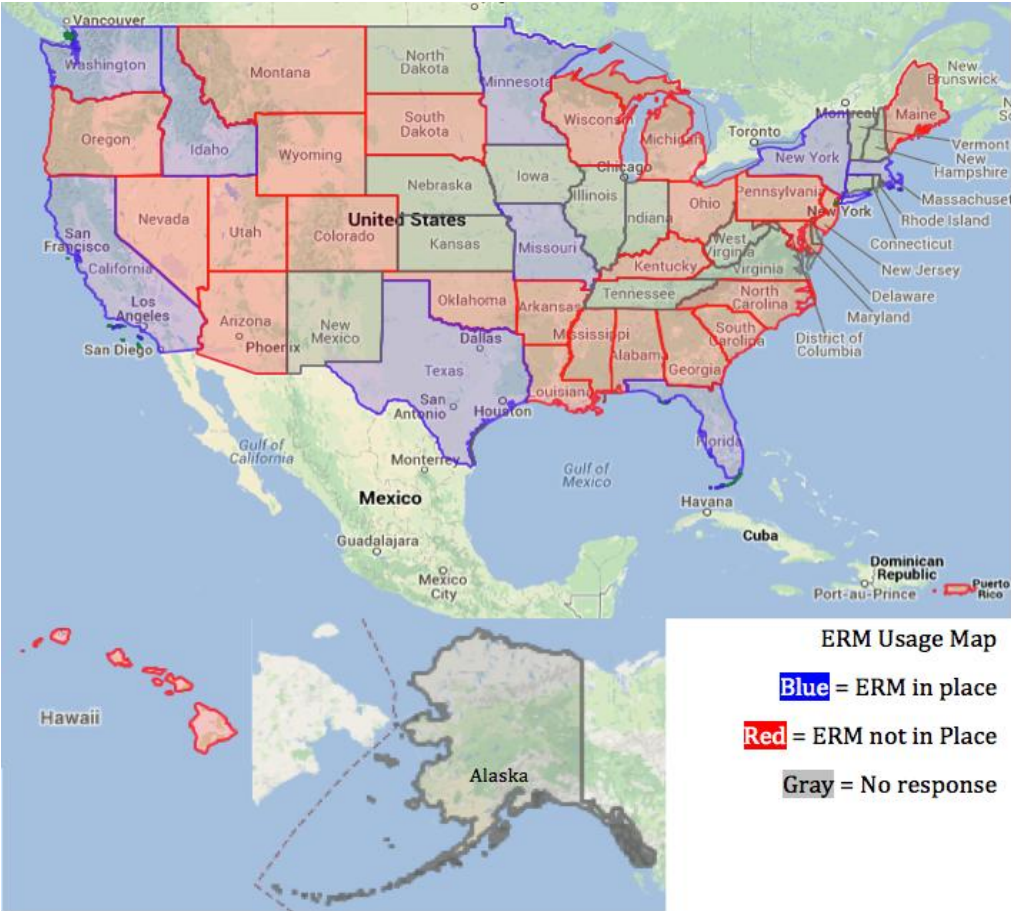


Table 1 provides a list of the DOTs with formal ERM policies or initiatives in place and when the programs were introduced. At the time of the survey, December 17, 2013, most DOTs indicated that their programs were initiated within the past two years.

Table 1: DOTs with Formal ERM and Implementation of ERM Date

DOT with Formal ERM Program	Date of Initial Implementation
California (CA)	February 2013
FHWA (Included to compare responses against state DOTs)	January 2013
Florida (FL)	No Date Provided by Respondent
Idaho (ID)	No Date Provided by Respondent
Massachusetts (MA)	June 2013
Minnesota (MN)	April 2013
Missouri (MO)	Summer 2013
New York (NY)	1987
Texas (TX)	2012
Washington (WA)	No Date Provided by Respondent

To determine the drivers of developing and implementing ERM, respondents were asked to select from a list of possible reasons. Most DOTs stated that better alignment with strategic objectives was a reason for developing and implementing ERM. Table 2 reflects the drivers behind developing and implementing ERM at the agencies.

Table 2: Drivers of ERM Implementation

Drivers of ERM Implementation (agencies selected all that apply)	# of Responding Agencies
Better Alignment of Operations with Strategic Objectives	73%
Effort to Develop Enterprise-Wide Risk Management Culture	64%
To Enhance Agency Governance	64%
Desire to Improve Consistency in Operational Performance	55%
Effort to Improve Public Perception/Confidence in Organization	55%
Response to Changing Risk Environment	36%
ERM Successes Observed at Other Agencies	27%
MAP-21 Requirement	18%
Other	64%

To investigate potential indicators of mature ERM programs, the respondents were asked to indicate the presence or absence of various elements and activities. The research team felt that certain measures, such

as having an individual or group in charge of risk management and having a formal agency ERM guidebook, could provide indications of mature or maturing programs. Table 3 reveals that eight of the agencies reporting formal ERM programs have one or more of the maturity indicators.

Table 3: DOTs with ERM Guidebooks, Executives, and Risk Registers

Elements Identifying Formal ERM <i>(agencies selected all that apply)</i>	# of Responding Agencies
Have a formal, published enterprise risk management guidebook/manual?	4
Have an executive (or group/committee) in charge of risk management?	6
Use a risk register to manage agency-level risks?	5

To begin to identify methods of risk management and categories of risks, respondents were asked how certain risk categories were managed at their organization. Table 4 provides insight into the management protocol for each risk category. Both Senior Management and Identification/Management at the Program Level were indicated in more than 50% of risk management methods. Interestingly, this exhibits a multi-level risk management approach. Human resource and asset risks are formally managed in some manner by each responding agency.

Table 4: Methods of Risk Management for Agency-Level Risks

Identifying and Managing Risk Types <i>(agencies selected all that apply)</i>	Senior Management Attention	Policies	Risk Registers	Quantitative Risk Analysis	Identified/managed at program level	Not formally identified/managed at this time
Risks to Strategic Goals/Objectives	66%	44%	11%	0%	55%	22%
Assets and Asset Management	44%	55%	33%	11%	88%	0%
Program Delivery	44%	44%	44%	22%	88%	0%
Human Resources	33%	44%	11%	0%	55%	33%
Policy/Political Change	55%	22%	11%	0%	22%	33%
Operations	33%	55%	11%	11%	77%	11%
Maintenance	33%	44%	22%	11%	77%	11%
Price/Market Fluctuations	22%	33%	11%	22%	44%	33%
Natural Disasters	44%	44%	0%	11%	33%	33%
Climate Change	33%	33%	11%	11%	22%	44%

From the results of the survey, the research team identified nine DOTs across the US that are employing ERM at their organization. When considering how all of these agencies are conducting ERM, the research team noted that every agency-level risk category in Table 4 is being managed by at least one transportation agency. This led to rich information regarding agency-level risks that affect strategic goals which was gathered through interviews and case studies in later tasks. The results also indicate that 64% of DOTs have an executive or a group/committee responsible for risk management. The responses regarding the identification and management techniques for agency-level risks interestingly revealed that many of the agencies are managing risks at the agency level and program level. Monitoring risks across the organization is believed by the research team to be a trademark of mature ERM and was explored during the case studies.

CASE STUDY RESULTS

The research team conducted case studies with five different State DOTs. This section provides a summary of the findings from each case study and a discussion of salient findings.

CALIFORNIA DOT (CALTRANS)

Agency and ERM Overview

Caltrans manages more than 50,000 miles of California's highway and freeway lanes, provides inter-city rail services, permits more than 400 public-use airports and special-use hospital heliports, and works with local agencies. The Department has been active in moving the people and commerce of California for more than 100 years from a loosely connected web of footpaths and rutted wagon routes to the sophisticated system that today serves the transportation needs of more than 30 million residents.

Caltran's Office of Enterprise Risk Management was established by their Executive Board in February of 2013, though research on ERM started in July of 2012. Caltrans took a top-down approach when implementing ERM and based their risk management standards on the International Standards Organization (ISO 31000). Caltran uses ERM as a tool to record, track, and address enterprise level threats and opportunities. Table 5 summarizes the key characteristics of the Caltrans ERM program.

Table 5: Caltrans – ERM Program Characteristics

Characteristics	Agency Responses
Origin	<ul style="list-style-type: none"> Used ISO 31000 framework to develop ERM program Top-down approach Research for ERM implementation began in July 2012 and office established February 2013 Caltrans contacted other agencies that had implemented ERM to see what drove the implementation of other programs
Date Implemented	<ul style="list-style-type: none"> February 2013
Drivers for Implementing	<ul style="list-style-type: none"> MAP-21 Requirement ERM successes observed at other agencies (MnDOT, TxDOT, NYSDOT, other CA state agencies, industry trends)

	<ul style="list-style-type: none"> • Effort to develop enterprise-wide RM culture • Effort to improve public perception/confidence in organization • To enhance agency governance • Response to changing risk environment • Better alignment of operations with strategic objectives • Add tools to improve efficiency of the development of projects • Response to changes in business community – best practices
Champion (s)	<ul style="list-style-type: none"> • ERM Department with a Chief Risk and Ethics Officer • Caltrans Director and Chief Deputy Director were also very strong supports of the program from the inception
Impact within Agency	<ul style="list-style-type: none"> • Executives are more comfortable in that their management is working/managing enterprise risks • Drives strategic performance measures • Provides more accurate measure of vehicle tracking with GPS to better understand needs of the department's fleet inventory and usage • Helped with cell phone usage – using risk assessment process they identified that they needed phones to communicate.
Recommendations /Best Practices	<ul style="list-style-type: none"> • Executive level support to the program is key • Risk champion at the senior level – ideally someone with departmental and ERM knowledge • Research is limited on ERM for transportation but it is important for the agency to spend ample time researching other sources to extract helpful and relevant information • If the organization wants ERM to succeed, they must allocate resources to the program • Don't only look at what other DOTs are doing – they might not have what you need

MASSACHUSETTS DOT (MASSDOT)

Agency and ERM Overview

The mission of the Massachusetts Department of Transportation is to deliver excellent customer service to people who travel in the Commonwealth, and provide the nation's safest and most reliable transportation system in a way that strengthens the economy and quality of life.

MassDOT implemented its ERM program in June of 2013. Taking a top-down approach, the agency used an outside consultant to help design and implement ERM. MassDOT's ERM program is based on the COSO (Committee of Sponsoring Organizations) framework for enterprise-wide risk management, Enterprise Risk Management - Integrated Framework (i.e., COSO II). The key MassDOT ERM program characteristics are summarized in Table 6.

Table 6: MassDOT – ERM Program Characteristics

Characteristics	Agency Responses
Origin	<ul style="list-style-type: none"> • Top-down approach • Used COSO (Committee of Sponsoring Organizations) framework to develop ERM program • ERM Champion had experience with ERM at previous employer and initiated ERM implementation at MassDOT • Consultant was hired to aid the implementation
Date Implemented	<ul style="list-style-type: none"> • June 2013
Drivers for Implementing	<ul style="list-style-type: none"> • Desire to improve consistency in operational performance • Effort to develop enterprise-wide RM culture • Effort to improve public perception/confidence in organization • Enhance agency governance • Response to changing risk environment • Better alignment of operations with strategic objectives • From a state government standpoint, it is a push to increase department transparency. • Taking a proactive approach counter to the reactive risk management approach.
Champion (s)	<ul style="list-style-type: none"> • Director of Audit Operations • ERM is housed in the Audit Department which has a staff of around 40
Impact within Agency	<ul style="list-style-type: none"> • Increase in audits of departments and units to evaluate risks and performance • Audit department has been receiving notable increases in requests for audits and requests for assistance of risk management in other areas
Recommendations/Best Practices	<ul style="list-style-type: none"> • ERM is an extremely beneficial process that can really help the agency • Implementation must be taken seriously – you must sell the concept to the organization • Get senior level support • Develop strong lines of communication and use them frequently • Involve the agency's board and have them help communicate the program's implementation • Even after ERM has been started, keep selling the concept of ERM and show the benefits that have been realized

MISSOURI DOT (MoDOT)

Agency and ERM Overview

MoDOT works with the public, transportation partners, state and federal legislators, and other state and local agencies to provide a safe and efficient transportation system to the people of Missouri. MoDOT takes an integrated approach to managing the various risks MoDOT faces with Missouri's extensive transportation system. In late 2012 and into early 2013, a MoDOT senior management team consisting of the 7 District Engineers and 24 Division Heads conducted an agency-level risk identification discussion to discover risks faced by the department. This risk identification process was the initial step to developing an

enterprise risk management system, which was formally implemented within the agency in November 2013. Table 7 summarizes the key characteristics of the agency.

Table 7: MoDOT – ERM Program Characteristics

Characteristics	Agency Responses
Origin	<ul style="list-style-type: none"> Used COSO (Committee of Sponsoring Organizations) framework to develop ERM program ERM resulted from an agency-level risk identification initiative involving district engineers and division heads
Date Implemented	<ul style="list-style-type: none"> Summer 2013
Drivers for Implementing	<ul style="list-style-type: none"> Effort to enhance agency governance
Champion (s)	<ul style="list-style-type: none"> Chief Financial Officer – no dedicated staff for ERM
Impact within Agency	<ul style="list-style-type: none"> Improvement to managing customer satisfaction ERM helps identify issues that might impact customer satisfaction – road closure during weather event, traffic signal outages, pavement condition deterioration, etc. Customer satisfaction surveys also drive more effective ERM – customer satisfaction surveys and ratings are used to identify risks
Recommendations/ Best Practices	<ul style="list-style-type: none"> ERM works and is valuable if your approach to running an organization is more team-centric For ERM to work, you have to be willing to get out of your part of the department and work with other divisions

WASHINGTON STATE DOT (WSDOT)

Agency and ERM Overview

The Washington State Department of Transportation manages more than 18,000 lane miles of state highways, operates the largest ferry system in the nation, provides rail service, and works with local agencies. The Washington State Department of Transportation is the steward of a multimodal transportation system and responsible for ensuring that people and goods move safely and efficiently.

It is the policy of the Washington State Department of Transportation (WSDOT) to proactively assess and respond to any risks that may affect the achievement of WSDOT's strategic and performance based objectives and their intended outcomes. This policy is implemented through the agency's ERM program. WSDOT originally adopted risk management to provide improved accountability for project delivery and to help define potential risks in program areas. The enterprise risk portion started with asset management as well but has now branched out into more areas across the agency. The ERM policy statement was officially developed in 2009 and the key aspects are summarized in Table 8.

Table 8: WSDOT – ERM Program Characteristics

Characteristics	Agency Responses
Origin	<ul style="list-style-type: none"> Multi-prong approach that essentially started with asset risk management (early '90s) and then branched into other areas of ERM ERM was developed in-house and formally adopted in 2009, through their policy statement
Date Implemented	<ul style="list-style-type: none"> 2009 (when ERM policy statement was formally adopted)
Drivers for Implementing	<ul style="list-style-type: none"> Desire to improve consistency in operational performance Effort to develop enterprise wide risk management culture Effort to improve public perception/ confidence in organization To enhance agency governance Better alignment of operations with strategic operations Ability to better assess risk across boundaries so that you can do Tradeoff analysis more successful Better understanding of risk allows you to better understand trading off across boundaries
Champion (s)	<ul style="list-style-type: none"> Director of ERM and Director of Safety Program Risk Management Several employees throughout the organization serve as 'ERM Champions'
Impact within Agency	<ul style="list-style-type: none"> Integrating risk in all aspects of employees' work – getting employees to think about risks and how to deal with risks is a key component of the program Increase in safety consciousness – many risks are associated with personnel safety which has led to more improvements around safety issues
Recommendations/ Best Practices	<ul style="list-style-type: none"> It is not easy to get an ERM Program implemented at the state level – persistence and patience is critical Get employees thinking in terms of risk and risk management, make it second nature Remain flexible to fit the needs of the organization at the time of implementation and modify the approach based on these needs Work with individual offices in their capacity

NEW YORK STATE DOT (NYSDOT)

Agency and ERM Overview

It is the mission of the New York State Department of Transportation to ensure those who live, work and travel in New York State, have a safe, efficient, balanced and environmentally sound transportation system. The agency coordinates and assists in the development and operation of transportation facilities and services for highways, railroads, mass transit systems, ports, waterways and aviation facilities.

Within NYSDOT, ERM sits under the Office of Audit and provides discretionary and mandated risk management services so that NYSDOT management can achieve its objectives. The state's Internal Control Act prompted the implementation of ERM to develop business plans, obtainable objectives, and performance measures. Teams created by the ERM executive staff work to get information from all departments to understand how the risks the agency faces could affect everything the agency does. Teams

are made up of individuals from divisions across the agency. Table 9 summarizes the NYSDOT ERM program.

Table 9: NYSDOT – ERM Program Characteristics

Characteristics	Agency Responses
Origin	<ul style="list-style-type: none"> Enterprise Risk Management Bureau (ERM) was formed as part of an agency reorganization and prompted by the State's Internal Controls Act Risk and Resource Management (pre-ERM) was initially a function of the Planning Division aligned with the Internal Audit function Used COSO (Committee of Sponsoring Organizations) framework to develop ERM program
Date Implemented	<ul style="list-style-type: none"> 1987
Drivers for Implementing	<ul style="list-style-type: none"> Desire to improve consistency in operational performance Effort to develop enterprise-wide risk management culture Effort to improve external perception/confidence in organization Enhance agency governance Response to changing risk environment Better alignment of operations with strategic objectives State governmental internal control requirements FHWA Division risk efforts (identifies top risks for delivering federal-aid program)
Champion (s)	<ul style="list-style-type: none"> Commissioner provides top management support for ERM NYSDOT has an Internal Control Officer who ensures that appropriate responses are taken to address risks and oversees ERM activities Internal Control Officer is the head of ERM and works with personnel throughout to coordinate risk management
Impact within Agency	<ul style="list-style-type: none"> Risk assessments help program managers choose where to allocate their resources to assure program objectives will be achieved Reasonable assurance is provided to top management that risks are being identified, assessed and addressed throughout all levels of the organization
Recommendations/Best Practices	<ul style="list-style-type: none"> Executive level support of the program is critical Get the 'top' individuals to direct and encourage others to participate Setting deadlines for people is essential to keeping the process moving and growing

SUMMARY OF FINDINGS AND EMERGING BEST PRACTICES

There were some similarities in the data collected in the case studies such as conducting formal risk identification workshops and the presence of an ERM champion within the agency. However, the responses were different for other elements such as the drivers for implementing ERM and whether the DOT considers agency-level risks as both threats and opportunities. This section discusses the seven elements of analysis for the case study investigations at the five DOTs and provides examples of ERM implementation from the various agencies. These elements also serve as the basis for emerging best practices within ERM. With ERM still in its infancy, specific evidence-based best practices were not formalized during this study; however, these elements can be foundational guidelines for DOTs considering or in the process of implementing ERM.

1. ORIGIN OF ERM PROGRAM

The origin of ERM focuses on *how* an agency implemented enterprise-level risk management, including the ERM framework chosen and the process for development. Enterprise risk management is a fairly new activity for US transportation agencies and most programs have been introduced in the past five years. There have been various frameworks created over the years to help agencies implement ERM, including *ISO-31000 Risk Management: Principles and Guidelines* (ISO 2009) and *COSO ERM Framework* (COSO 2004). Four of the five DOT case studies revealed that one of these two industry standards were used as guidance during initial ERM development. In addition to using existing frameworks, several agencies noted that they conducted extensive research on how transportation agencies outside of the US (e.g., the UK and Australia) are implementing ERM. Further, several agencies noted using both existing frameworks and external research. Table 10 below outlines these methods as well as identifies the number of agencies using each from this investigation.

Table 10: ERM Frameworks for Implementation

Framework Model	Brief Description	# of Agencies
ISO-31000 Risk Management: Principles and Guidelines (<i>ISO 2009</i>)	Provides principles, framework and a process for managing risk. Using ISO 31000 can help organizations increase the likelihood of achieving objectives, improve the identification of opportunities and threats and effectively allocate and use resources for risk treatment.	1
COSO ERM Framework (<i>COSO 2004</i>)	A widely accepted framework used by management to enhance an organization's ability to manage uncertainty, consider how much risk to accept, and improve understanding of opportunities as it strives to increase and preserve stakeholder value.	3
Other Transportation Agencies' ERM Frameworks	Many transportation agencies outside of the United States have successfully implemented robust ERM programs and can serve as a very valuable baseline for State DOTs. Many of these ERM programs are mature and the agencies are willing to share best practices and lessons learned. Countries noted included Australia and the United Kingdom.	3

In addition to identifying the framework used, several agencies noted they implemented ERM with a top-down approach, stating it was extremely important to have senior support when developing ERM. Other common reasons that served as the impetus for ERM included senior executives with previous ERM experience from other agencies or push from board or state governance.

2. FACTORS INFLUENCING ERM IMPLEMENTATION

The second element analyzed during this investigation was factors that influenced ERM implementation. A list of common factors was developed based on the preliminary survey and was provided to the five agencies during the case analyses. Agencies identified the factors applicable to their program and identified additional reasoning, where applicable. Table 11 lists the eight common factors and the agencies' responses.

Table 11: Factors Influencing ERM Implementation

	MAP-21 Requirement	ERM successes observed at other agencies	Desire to improve consistency in operational performance	Effort to develop enterprise-wide risk management culture	Effort to improve public perception/confidence in organization	Effort to enhance agency governance	Response to changing risk environment	Better alignment of operations with strategic operations
Caltrans	X	X		X	X	X	X	X
MassDOT			X	X	X	X	X	X
MoDOT						X		
WSDOT			X	X	X	X		X
NYSDOT			X	X	X	X	X	X
	1	1	3	4	4	5	3	4

Participants were also asked to provide additional drivers leading to the decision to implement formal ERM programs. Additional factors included:

- Add tools to improve efficiency of the development of projects (Caltrans)
- Ability to better assess risk across boundaries so that you can do tradeoff analysis more successful (WSDOT)
- Response to changes in business community – best practices (Caltrans)
- FHWA Division risk efforts (identifies top risks for delivering federal-aid program) (NYSDOT)
- Past experience of ERM champion (MassDOT)
- From a state government perspective, there was a push to increase department transparency (MassDOT)
- Taking a proactive approach rather than reactive approach to risk management (MassDOT)

3. ORGANIZATIONAL SUPPORT AND STRUCTURE

The case study agencies all received support from the executive level in the development and implementation of their ERM programs; however, the notable roles and responsibilities of ERM were observed in the ERM champions of the agency. Respondents from each agency indicated that the ERM

effort was only possible with the support and participation of many individuals throughout the agency. However, the roles these supporting members played were often informal or were required through participation in the aforementioned ERM processes. The roles of key members involved with the ERM program are highlighted in Table 12.

Table 12: Organizational Location, Roles and Responsibilities of Key Individuals in DOT ERM Efforts

Agency	Individual's Title	Roles & Responsibilities
Caltrans	<ul style="list-style-type: none"> Chief Risk and Ethics Officer – ERM Department 	<ul style="list-style-type: none"> Responsible for development of overall ERM process – having framework and structure to reach out to broader business community Customizing framework to help executive management find connections between strategic plans they have and other work programs/products and the risks they face Ensure all the primary programs (IT, Project management) have some sort of risk management activities Ensuring there is cohesiveness between the different divisions to grow the ERM culture and common language Regularly assessing risks that impact strategic goals Report to executive board
MassDOT	<ul style="list-style-type: none"> Director of Audit Division 	<ul style="list-style-type: none"> Driver of the process Getting support/buy-in from senior members of the Agency Develop ERM program into a completely internal process – no aid from consultants Develop the ERM program to where it is a living process that has the four major areas of the Agency thinking of risk from a strategic standpoint Get the ERM program to actively manage strategic risks as opportunities. "Risks are often thought of as only negative, but they can in fact be very positive and rewarding to the department."
MoDOT	<ul style="list-style-type: none"> Chief Financial Officer 	<ul style="list-style-type: none"> Driver of the ERM process Initially worked with Senior Management Team to educate them on ERM Facilitate the identification/assessment/development of controls for agency-level risks Identifying what has been overlooked Development of a risk control document
WSDOT	<ul style="list-style-type: none"> Director of Enterprise Risk and Safety Management 	<ul style="list-style-type: none"> Lead facilitator of the identification/assessment/ development of controls for agency-level risks Assists individuals with understanding how agency-level risks affect their area/department Educating individuals throughout the agency on ERM and their department's role in managing risks
	<ul style="list-style-type: none"> Highway Safety Program Manager – ERM Department 	<ul style="list-style-type: none"> Leads the communication efforts of the ERM program and corresponding processes Works with staff-level up to director-level to aid the understanding of the basics of ERM and related topics Works to develop and improve the processes in place
NYSDOT	<ul style="list-style-type: none"> Internal Control Officer 	<ul style="list-style-type: none"> Head of ERM Office and works with personnel throughout to coordinate risk management Ensures that appropriate responses are taken to address risks and oversees ERM activities

Three of the agencies investigated in the case studies had an ERM organizational unit in place to guide the ERM efforts. These formal ERM departments were each led by a senior-level individual who spearheaded the ERM processes at their agency. They also aided the ERM development and implementation process at their agency. Champions of the ERM efforts at the agencies with formal ERM departments were identified

as the directors of the respective ERM divisions. WSDOT, which has the longest standing ERM program of those investigated, indicated that the ERM efforts are supported by many individuals throughout the Agency's ERM division and led by the division's Director. Caltrans also has dedicated a formal ERM division that consists of many individuals and guided by the Chief Risk and Ethics Officer.

The other two agencies investigated do not have formal ERM departments but have individuals who led the ERM efforts and had also participated in the development and implementation of ERM at the agency. The ERM champion of MassDOT was the agency's Chief Financial Officer. The Director of Audit Operations championed MoDOT's ERM efforts. Like the agencies with formal ERM divisions, these ERM champions coordinate the agency-level risk identification, assessment, and development of controls.

4. PROCESSES OF ERM IMPLEMENTED

The specific processes associated with agency-level risk identification, assessment of these risks, and development of controls for the risks was discussed and investigated with each agency representative.

Risk Identification

Each of the agencies investigated conduct formal risk workshops to identify agency-level risks facing the agency. Two of the agencies perform the workshops annually, one agency identifies agency-level risks every other year, and two agencies conduct workshops on an ongoing basis with different divisions of the agency. Table 13 describes the individuals that participate in the risk identification workshops, as well as the frequency of the workshops.

Table 13: Agency-Level Risk Identification Processes

Agency	Participants	Frequency
Caltrans	<ul style="list-style-type: none"> • Executive, senior management, and key staff from each district/program • Managers from Office of ERM • Managers from Audits and Investigations Division 	Every other year
MassDOT	<ul style="list-style-type: none"> • Senior management members (director level and up) representing the different departments/units of the agency • Director of Audit Division 	Annually
MoDOT	<ul style="list-style-type: none"> • Senior Management Team: <ul style="list-style-type: none"> ○ District engineer from each of 7 districts ○ Division head from each of 24 divisions • Chief Financial Officer 	Annually
WSDOT	<ul style="list-style-type: none"> • Directors of divisions • Director of ERM Department • Representatives of ERM Department 	Ongoing
NYSDOT	<ul style="list-style-type: none"> • Managers throughout the agency in each of the program areas identify risks, both at the Office and Bureau level 	Ongoing

Risk Assessment

Each of the investigated agencies conducted risk assessment of the agency-level risks with the same individuals that participated in the risk identification workshops. These individuals were typically at the director or executive level of the agency and in some instances key staff from the different departments also participated in the identification process. To measure the agency-level risks, all of the agencies at least assessed the risks by two characteristics: (1) Likelihood of occurrence and (2) Impact/consequence if risk is realized. Four of the agencies assess the controls currently in place or the agency's readiness to respond to the risk if it if realized. WSDOT assesses severity and likelihood of each risk and those values are plotted on a heat map to determine the level of risk for each agency-level risk. The level of risk provides the agency with an understanding of the priority level of the risk and a description of the consequences associated with the risk. Table 14 provides an overview of the assessment processes at the different agencies.

Table 14: Risk Assessment Topics and Measurement Scales of Agencies

Agency	Topics Assessed for Agency-Level Risks	Scale
Caltrans	<ul style="list-style-type: none"> • Likelihood • Impact • Controls in Place • Objectives Most Affected by Each Risk 	Likelihood and impact assessed on a scale of 1 – 3
MassDOT	<ul style="list-style-type: none"> • Likelihood • Impact • Level of Management Control 	Likelihood, impact, and level of management assessed on a scale of 1 – 5
MoDOT	<ul style="list-style-type: none"> • Likelihood • Impact • Readiness 	Likelihood, impact, and readiness assessed on scale of 1 – 4
WSDOT	<ul style="list-style-type: none"> • Severity (impact) • Likelihood • Level of Risk 	Severity and likelihood are assessed on a scale of 1 – 5. Level of risk is determined on a scale from 1 – 4
NYS DOT	<ul style="list-style-type: none"> • Likelihood • Impact • Controls in Place 	Likelihood and impact assessed on a scale of 1 – 4

Development of Controls to Manage Risks

The development of controls at the agencies was the most unique process observed in the investigation. Similar to the risk assessment process, the same individuals who participated in the risk identification also participated in the development of controls for agency-level risks. The level of detail regarding establishing controls was notably different across the agencies. Caltrans would discuss the actions already taken or those in progress and then determine planned actions for the appropriate management of the risk. MassDOT developed a series of questions to discuss that would provide insight into the controls for the risks.

WSDOT performs a two-step process for developing controls. First, the individuals that participated in the risk identification and risk assessment will determine a risk response (transfer, accept, mitigate/leverage, avoid) depending on each individual risk's severity level. Second, the group develops an action plan to carry out the strategy to manage the risk. The action plan consists of two parts: (1) Risk response plan and

(2) Implementation plan. A risk response plan is a permanent plan to address the risk and its potential consequences. The implementation plan considers all resources necessary to implement the risk response plan. Examples of controls for strategic risks for various agencies are presented in Appendix C.

5. CHANGES IMPLEMENTED TO IMPROVE/STRENGTHEN ERM PROGRAM

The study intended to determine how ERM programs have been improved overtime. However, due to the infancy of ERM, many agencies have not had sufficient time to implement these types of measures. One agency, WSDOT, which implemented ERM in 2009, had significant documented results regarding changes made to improve their ERM program. The most notable changes in the ERM program at WSDOT dealt with areas regarding safety and the agency's assets. According to WSDOT, changes regarding safety were more easily implemented due to the ease of measuring safety risks. For example, it is easy for an agency to track the number of worker injuries on transportation construction projects and the number of fatalities suffered by road users on the transportation system. Efforts at WSDOT to improve safety are targeted at areas where the agency is not reaching the performance measurements in place. Considering implementations regarding assets, WSDOT is able to make tradeoffs between different projects and programs based on the risks associated with the different potential projects and program areas.

Representatives from the newer ERM programs all explained that their efforts are to design and implement processes that can improve the program. Below are several improvements required noted by the various agencies to improve ERM over time.

People

- *Training* – agencies noted the importance of implementing more robust training programs for employees around enterprise risk management, including risk definitions, the importance of enterprise risk management, and how risk management impacts should be integrated into each employee's daily responsibilities.
- *Team-Centric Approach* – create a team environment around ERM through identifying, assessing, and management risks. Agencies noted that by having more people participate in ERM, more risks that might have been missed, will be identified.
- *Multi-Level Input* – meet with employees from various levels within the agency to understand agency-level risks from a different perspective than what is provided by senior/executive members. Also, consider input from external stakeholders.

Communication

- *Internal* – increase communication of the ERM program and processes throughout the agency, on a regular basis. Agencies need to keep conveying the impact of ERM, even after ERM has been implemented. Agencies noted the importance of showing success stories and how the agency is benefiting from ERM regularly.
- *External* – communicate the agency's mission around ERM to the public, specifically on how the agency is identifying and addressing key enterprise risks, and establish a formal process for discussions with public regarding risks.

ERM Process Advancement

- *Threats and Opportunities* – many new ERM programs typically only consider risks as threats to the agency; therefore, get the ERM program to actively consider agency-level risks as both threats and opportunities.
- *Risk Assessment Process* – research and implement more advanced risk assessment processes, including quantitative and probabilistic risk analysis.
- *Performance Measures* – develop performance measures for the ERM program.
- *Internal Audit* – begin conducting internal audits on the agency's ERM program, to help identify what works and what does not work as well as prioritize needs around ERM.

6. RESULTS ACHIEVED DUE TO ERM IMPLEMENTATION

The interviewees believe that the value of implementing ERM is clearly evident, and the research concurs across both the case studies and the preliminary survey participants. The following is an aggregated list of the results achieved by the implementation of an ERM program based on the case study findings:

- Provides assurance to the executive level that their management is working/managing these risks.
- Drives strategic performance measures.
- Identifies specific needs to improve agency operations (e.g., one agency noted that through the risk assessment process they identified the need for phones to communicate more efficiently and therefore implemented cell phones for certain employees).
- Increase in audits of departments/units to evaluate risks and performance.
- Improvements to resource management (e.g., one agency noted that ERM led to more accurate measure of vehicle tracking with GPS to better understand needs of the department's fleet inventory and usage).

7. LESSONS LEARNED AND RECOMMENDATIONS FOR OTHER DOTs

Lastly, case study participants were asked what lessons were learned through ERM implementation and/or what recommendations, if any, they would have for other DOTs as they develop an ERM program. Below is an aggregated list of these lessons learned / recommendations.

Getting Started

- *Research* – investigate other ERM programs in place and modify these approaches to fit the needs of the agency and what is desired from the ERM program. There is limited documented experience with ERM in transportation agencies; therefore, agencies will need to ensure they spend ample time reviewing various resources. Further, agencies should not just focus on other DOTs and should explore different types of agencies, both geographically and functionally.
- *Team Environment* – ERM is valuable if the approach to running the organization is more centered on a team environment, "For ERM to work, the individuals have to be willing to get out of their part of the department and work with other divisions." ERM requires enterprise management versus functional management.

Organizational Support

- *ERM Champion* – have a risk champion at the senior level, ideally someone with departmental and ERM knowledge.
- *Agency-Wide Support and Involvement* – ERM must be “sold” to the organization in order to get individuals on board and actively participating. Work with individuals at every level and within every department/division to get buy-in from everyone.
- *Executive Support* – commonly, participants stated that executive support for ERM program was critical for success. Executive support helps with allocation of funds to improve/implement the ERM program and promoting individuals to actively participate in risk identification workshops, assessment processes, and the development of controls.

Resources

- *Resource Allocation* – an effective ERM program requires the necessary resources to be developed, implemented, and improved. Once implemented, be straightforward with executives about the resources the program needs to be successful and effective.
- *Tools* – identify the tools the agency’s ERM program will need and determine the resources necessary to implement. Ensure the tools are developed far enough along before fully implementing the ERM program.

Ongoing Improvement

- *Communication* – develop and implement effective means of communication regarding ERM and use them frequently. Let it become common practice for individuals to discuss risks and how they will be managed and be sure to communicate benefits realized from the ERM program so individuals throughout the agency see the benefits.
- *Dynamic Execution* – an effective ERM program will be dynamic rather than static, and it will grow and develop with the changing risk environment that the agency operates in. Therefore, the agency should be prepared to adapt and change the ERM program, as needed.

CHAPTER 4 CONCLUSION AND OBSERVATIONS

KEY OBSERVATIONS

The research led to six key observations around ERM implementation:

1. *State DOT ERM programs are in their infancy*

Based on the findings from this research and the previous NCHRP 20-24 (74) study, it is evident that ERM programs within State DOTs are fairly new. Many State DOTs still do not have formal and explicit ERM policies. Few State DOTs have formal programs and those that exist are, admittedly by the DOTs, still developing. Looking at the case studies from this research, three out of the five agencies have only been employing ERM for around two (2) years at the time of the interviews. Research into international programs has shown that the mature programs have been in existence for more than 10 years (FHWA 2012). However, with the enactment of Map-21 and the further development of ERM programs internationally, ERM is becoming a more common practice within US transportation agencies.

2. *DOTs are leveraging industry-standard ERM guidelines and frameworks*

With ERM being a new endeavor for almost all DOTs, it is beneficial for the agencies to follow industry-standard guidelines to implement ERM. The two most prevalent standards are the ISO 31000 Risk Management -- Principles and Guidelines (ISO 2009) and the Treadway Commission's Enterprise Risk Management – Integrated Framework (COSO 2004). The use of these industry standard frameworks has saved agencies time and effort in implementation. While these frameworks are not transportation specific, the case study agencies were able to adapt them to their needs and cited them frequently for their usefulness. As more transportation agencies follow these industry-standard frameworks, there will be additional opportunities for sharing tools and lessons learned. The authors would also encourage other agencies to use the case examples from this research as another source of information when structuring their program to fit the unique organizational needs of their agency. The use of the standard guidelines and agency case studies will assist in a more rapid implementation of ERM in the transportation sector.

3. *ERM champions are critical for implementation success*

Although the case studies and survey responses found that programs vary in their maturity and rate of implementation, the agency personnel consistently cited the need for a dedicated ERM champion to advance their program. The ERM champion is an individual who sets the direction for ERM and promotes its implementation within the agency. The champion should understand ERM. Frequently, this individual may have some experience with ERM at another agency. The ERM champion should be able to provide evidence, either through empirical evidence or anecdotes, for the positive benefit that ERM can bring to the agency. They are often accountable to ensure that the agency stays on target during implementation and assures the program is adopted and integrated properly within the agency. All case studies within this research had an ERM champion and clearly noted his or her importance with initiating and sustaining the ERM programs.

4. *Designating a stand-alone ERM office is not a requirement*

Although several agencies noted that they had an office within their agency dedicated solely to ERM, this did not appear to be a requirement for a successful ERM program. As noted in the case studies, three out of five agencies actually had their ERM programs under another office or department and noted no issues with this structure. In fact, in some cases, agencies noted being under another office was beneficial, as it helped reduce costs and improved efficiency by having the right people involved in ERM. Example offices/departments in which ERM sat under included Internal Controls, Audit, and Finance. However, the absence of an ERM-specific office does not negate the need for an ERM champion, as previously discussed.

5. *Initial evidence is demonstrating tangible evidence of ERM benefits*

Even though ERM programs are not yet fully integrated into DOT operational structures, agencies are already reporting on the benefits of risk management. Agencies noted that ERM drives strategic performance measures, identifies specific needs in the agency and cuts across departments to identify problems that result in saving time or money. At this point, benefits are primarily qualitative but agencies are starting to implement performance measures, to better track ERM impact within the agency. The most fruitful opportunities for performance tracking may come from the risk-based asset management programs that are still developing.

6. *DOTs recognize the importance of continually improving their ERM programs*

ERM provides many initial benefits early in the implementation process. However, agencies are finding that full implementation is a multi-year endeavor. The case study DOTs are already considering ways in which they can improve ERM in their agencies. A major part of this research involved looking at initiatives to advance ERM within the agency. DOTs are looking into innovative solutions such as integrating their employees more into the risk management process, communicating risk both internally and externally, and adding more robustness to the risk assessment process. All these initiatives are clear signs that DOTs want to keep ERM in place and believe that, by having a more advanced risk management program, it will better improve their operations, product and service delivery.

FUTURE RESEARCH

With ERM being in its infancy at many DOTs, there are opportunities for future research. The research team identified three broad areas for continued research.

1. *ERM Program Growth & Development*

Continuing research is needed on how DOTs are implementing and growing their ERM programs. With such a small sample of agencies having formal programs, there is much to be learned about how to accelerate growth and sustain program benefits. Important research questions include:

- What common changes have transportation agencies needed to make when adopting industry-standard guidelines such as the ISO and COSO frameworks?

- What are the most common goals of transportation agency ERM programs and how are the agencies structuring their programs within their programs to achieve these goals?
- What ERM knowledge deficiencies are most prevalent in transportation agencies and how can training programs be designed to alleviate these needs?
- What new tools do agencies need to identify, assess, mitigate and manage risks at the enterprise level and can these tools be developed in a scalable manner for use by all agencies?

2. *Quantitative Benefits Realization*

Initial qualitative benefits were clearly noted and evident during this study; however, the management of Benefits Realization as part of ERM implementation and improvement will assist agencies in realizing the anticipated returns on investment from formal ERM programs. Important research questions involve:

- What are the costs to implement and maintain an ERM program, what are the benefits, and what is required to realize these benefits?
- How can an agency measure risks that have been avoided and opportunities that have been found through ERM programs?
- How can risk assessment and decision-making methods help us to improve asset management process, as well as the overall conditions of our assets?

3. *Integrating ERM within the Agency*

In order to have a successful ERM program, risk management needs to be embedded in the agency's culture and be a part of employees' daily responsibilities. Important research questions include:

- How are agencies integrating ERM across the organization and how ERM is being institutionalized?
- What agency functions see the greatest benefits from risk-based management approaches?
- What specific organizational changes are required to achieve a mature risk management organization?

REFERENCES

Aon Corporation (2010). Global Enterprise Risk Management Survey 2010. Aon Corporation, Chicago, IL.

Berry, A. and Phillips, J. (1998). "Enterprise Risk Management: Pulling it Together." Risk Management, 45(9): 53-58.

COSO (2004). Enterprise Risk Management – Integrated Framework. Committee of Sponsoring Organizations of the Treadway Commission (COSO), PricewaterhouseCoopers LLP, New York, NY.

Federal Highway Administration. "Asset Management Questions and Answers." MAP-21 Moving Ahead for Progress in the 21st Century. 25 September 2012. Web. 14 November 2013.

FHWA (2012). Transportation Risk Management: International Practices for Program Development and Project Delivery. FHWA Report FHWA-PL-12-029, U.S. Department of Transportation, Washington, D.C.

Hallowell, M., Molenaar, K., and Fortunato, B. NCHRP 20-24(74): Executive Strategies for Risk Management by State Departments of Transportation. Transportation Research Board. Washington D.C., 2012.

ISO (2009). ISO 31000 Risk Management -- Principles and Guidelines. International Organization for Standardization, Geneva, Switzerland.

Meulbroek, L.K. (2002). A Senior Manager's Guide to Integrated Risk Management. Journal of Applied Corporate Finance, Vol. 14, No. 4, pp. 56-70.

Molenaar, K., Anderson, S., and Schexnayder, C. NCHRP Report 658: Guidebook on Risk Analysis Tools and Management Practices to Control Transportation Project Costs. Transportation Research Board. Washington, D.C., 2010.

Nocco, B.W., Stulz, R.M. (2006). Enterprise risk management: theory and practice. Journal of Applied Corporate Finance, Vol. 18, No. 4, pp. 8–20.

APPENDIX A: SURVEY QUESTIONNAIRE

Enterprise Risk Management at State Departments of Transportation

Q1 NCHRP Project 08-36 Task 121: Successful Implementation of Enterprise Risk Management in State Transportation Agencies

You are being invited to participate in a study of enterprise risk management practices and strategies for state departments of transportation on behalf of the AASHTO Standing Committee on Planning National Cooperative Highway Research Program (NCHRP) Project 08-36 Task 121.

The objectives of this research are to: (1) identify state transportation agencies who are using enterprise risk management to achieve the organization's strategic goals and objectives; (2) understand the variation of formal risk management programs across different agencies; and (3) improve the overall enterprise risk management body of knowledge. The University of Colorado is teaming with Parsons Brinckerhoff to build on prior research and address critical issues facing transportation agencies. Your individual privacy will be maintained in all published and written data resulting from this study. We expect the project to benefit you by providing a summary of the current state-of-practice of enterprise risk management in transportation agencies across the country. You will receive no compensation for your participation. Completing the questionnaire will take approximately 15 minutes.

Q2 I understand the above information and voluntarily consent to participate in the research project entitled NCHRP 08-36 Task 121 Successful Implementation of Enterprise Risk Management in State Transportation Agencies.

1. Yes (1)
2. No (2)

If No Is Selected, Then Skip To End of Survey

Q3 Please complete the following information. Note: We are collecting names only to avoid duplication when aggregating results. Your individual privacy will be maintained in all published and written data.

First Name: (1)

Last Name: (2)

Organization: (3)

Job Title and/or Organizational Unit: (4)

Q29 Please indicate your state.

3. Alabama (1)
4. Alaska (2)
5. Arizona (3)
6. California (4)
7. Colorado (5)
8. Connecticut (6)
9. Delaware (7)
10. District of Columbia (8)
11. Florida (9)
12. Georgia (10)
13. Hawaii (11)
14. Idaho (12)
15. Illinois (13)
16. Indiana (14)
17. Iowa (15)
18. Kansas (16)
19. Kentucky (17)
20. Louisiana (18)
21. Maine (19)
22. Maryland (20)
23. Massachusetts (21)
24. Michigan (22)
25. Minnesota (23)
26. Mississippi (24)
27. Missouri (25)
28. Montana (26)
29. Nebraska (27)
30. Nevada (28)
31. New Hampshire (29)
32. New Jersey (30)
33. New Mexico (31)
34. New York (32)
35. North Carolina (33)
36. North Dakota (34)
37. Ohio (35)
38. Oklahoma (36)
39. Oregon (37)
40. Pennsylvania (38)
41. Rhode Island (39)
42. South Carolina (40)
43. South Dakota (41)

- 44. Tennessee (42)
- 45. Texas (43)
- 46. Utah (44)
- 47. Vermont (45)
- 48. Virginia (46)
- 49. Washington (47)
- 50. West Virginia (48)
- 51. Wisconsin (49)
- 52. Wyoming (50)
- 53. Arkansas (51)
- 54. Puerto Rico (99)

Q4 Are you available for additional questions or do you wish to receive the results of this effort? (Check all that apply)

- Available for additional questions (1)
- Not available for additional questions (2)
- Please contact me with the results (Provide email address) (3) _____
- Please do not contact me with the results (4)

Q29 Does your organization have a formal enterprise risk management policy or enterprise risk management activities/directives in place?

- 55. Yes (1)
- 56. No (2)

If No Is Selected, Then Skip To End of Survey

Q32 Was your organization's decision to develop and implement enterprise risk management driven by one or more of the following? (Select all that apply)

- MAP-21 requirement (1)
- Enterprise risk management successes observed at other agencies (Please list agency or agencies)
(2) _____
- Desire to improve consistency in operational performance (3)
- Effort to develop enterprise-wide risk management culture (4)
- Effort to improve public perception/confidence in organization (5)
- To enhance agency governance (6)
- Response to changing risk environment (7)
- Better alignment of operations with strategic objectives (8)
- Other (9) _____
- Other (10) _____

Q19 When was your organization's enterprise risk management framework completed and put into operation? (Please indicate month and year)

Q9 Does your organization have a formal, published enterprise risk management guidebook/manual?

- 57. Yes (1)
- 58. No (2)

Q28 Does your organization have an executive (or group/committee) in charge of risk management?

- 59. Yes (1)
- 60. No (3)

Q23 Does your organization use a risk register to manage agency-level risks?

- 61. Yes (1)
- 62. No (2)

Q14 How was your organization's enterprise risk management framework developed?

- Using an established framework, developed outside the organization (e.g. International Standards Organization (ISO) or Committee of Sponsoring Organizations (COSO)) (1)
- Framework was developed in-house without reference to options 1 - 3 (2)
- Framework was adapted from another transportation agency (3)
- Framework was adapted from another industry/private sector (4)
- Other (6)

Answer If Does your organization have a formal, published ERM guide... Yes Is Selected

Q12 If your organization's enterprise risk management guidebook/manual is available in electronic form, can you share it with us via email or via the web?

- 63. Enterprise risk management guidebook/manual will be sent to timothy.mcguire@colorado.edu (1)
- 64. Available at the following web address (2) _____
- 65. Not available electronically (3)

Answer If What is the title of the individual (or group) in charge ... Is Selected

Q35 What is the title of the individual (or group) in charge of risk management at your organization?

Answer If What is the title of the individual (or group) in charge ... Is Selected

Q30 What is this individual's (or group's) location in the organization? (e.g. program, audit, planning)

Answer If Does your organization use a risk register to manage agen... Yes Is Selected

Q24 How often is the agency-level risk register updated?

- 66. Monthly (1)
- 67. Quarterly (2)
- 68. Semiannually (3)
- 69. Annually (4)
- 70. Other (5) _____

Answer If How was your organization's ERM framework developed? Other Is Selected

Q15 Please describe how the enterprise risk management framework at your organization was developed. Include titles of individuals, departments/committees, and any outside consultants involved in the development process.

Answer If How was your organization's ERM framework developed? Framework was developed in-house Is Selected
Q16 Please describe how the enterprise risk management framework at your agency was developed in-house. Include titles of individuals involved, departments/committees involved, and other relative information.

Answer If How was your organization's ERM framework developed? Framework was adapted from another DOT Is Selected

Q17 What transportation agency was the enterprise risk management framework at your organization modeled after?

Answer If How was your organization's ERM framework developed? Framework was adapted from another industry/private sector Is Selected

Q18 What industry/company was the enterprise risk management framework at your organization modeled after?

Answer If How was your organization's enterprise risk management fr... Using an established framework, developed outside the organization (e.g. International Standards Organization (ISO) or Committee of Sponsoring Organizations (COSO)) Is Selected

Q33 Which framework (e.g. ISO, COSO, etc.) was used in the development of your organization's enterprise risk management program?

Q25 How are the following risk types identified and/or managed at your organization? (Select all that apply)

	Senior Management (1)	Policies (2)	Risk Registers (3)	Quantitative Risk Analysis (e.g. Monte Carlo simulations) (5)	Risk type is identified and/or managed at the program/division level (6)	Risk type is not formally identified and/or managed at this time (7)
Risks to Strategic Goals and Objectives (1)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Assets and Asset Management (2)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Natural Disasters (3)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Climate Change (4)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Program Delivery (5)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Human Resources (6)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Policy/Political Change (7)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Operations (8)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Maintenance (9)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Price/Market Fluctuations (10)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q36 OPTIONAL QUESTIONS - This is the last page of the questionnaire.

Q31 Please provide us with some lessons learned concerning enterprise risk management that would be beneficial to other organizations.

Q32 Please provide us with any documents used by your organization relating to enterprise risk management that would be beneficial to the research of enterprise risk management at state transportation agencies.

- Web address of document (1) _____
- Document(s) will be emailed to timothy.mcguire@colorado.edu (2)
- Web address of document (3) _____
- Web address of document (4) _____

Q33 Do you know of any individuals at your organization that would be able to provide us with more information concerning enterprise risk management at state transportation agencies and/or complete this survey?

- 71. Yes (please provide email address or contact number) (1) _____
- 72. No (2)
- 73.

Answer If your organization's enterprise risk management guidebo... Enterprise risk management guidebook/manual will be sent to timothy.mcguire@colorado.edu Is Selected

Q31 Will you please email your organization's enterprise risk management guide/manual to timothy.mcguire@colorado.edu?

Q29 We appreciate you taking the time to take this survey and your help with this project. If you have selected that you would like to receive the results of this survey, we will distribute them once the responses are collected and aggregated.

Thank you.

APPENDIX B: INTERVIEW QUESTIONS

ERM General Context

1. How do you define Enterprise Risk Management?
2. Are your organization's strategic goals and objectives documented and available to the organization and/or public?

Risk Identification

3. How does your organization identify agency-level risks?
 - a. How often do you identify new/emerging agency-level risks?
 - b. Who is involved?
 - c. What tools do you use?
 - d. Are both threats and opportunities considered?
4. What are the major threats/risks to your strategic objectives?

Risk Assessment and Response

5. How does your organization assess/evaluate agency-level risks?
6. What is the process for determining a response to an agency-level risk?
7. For risks that are considered as opportunities, how is the risk assessment and response process different?

Risk Monitoring

8. How do you monitor the success of ERM response?
 - a. Who is involved/responsible?
 - b. What tools/systems are used?

Risk Communication

9. How are agency-level risks communicated throughout the organization?
10. How are ERM processes and lessons learned communicated throughout the organization?
11. How does your organization communicate agency-level risks and the management of these risks with external stakeholders/the public?

Lessons Learned/Best Practice

12. How is the effectiveness of your organization's ERM program evaluated? Who takes part in this and how frequently does it occur?
13. How are past data and lessons learned incorporated into the ERM program?
14. What changes had to be made within the agency/organization when ERM was implemented ERM?
15. What were your biggest challenges in developing and implementing ERM?
16. What advice would you give to an agency that is in the process of developing and implementing their own formal ERM program?

APPENDIX C: EXAMPLES OF RISK CONTROLS

The development of controls at the agencies was the most unique process observed in the investigation. Below are several examples of controls for strategic risks for various agencies.

Table C-1. Example of Agency-Level Risk Controls 1

Risk Category: Engage and Support Employees		<p>Action Taken or in Progress:</p> <ul style="list-style-type: none"> • Pay Parity efforts have been made for some classification groups based on salary compaction issues, and salary and classification studies. The Agency and the HR department are working cooperatively on various classification studies which includes pay analysis for Personnel Specialists, Environmental Planner and Aviation Consultant, etc. • The Agency Motivation Guidebook and associated website were published in 2012, in response to the 2011 Strategic Priority performance measure calling for ways to motivate employees and improve morale. • The first Employee Appreciate Day occurred in March 2013 and will continue on an annual basis. <p>Planned Action:</p> <ul style="list-style-type: none"> • The Agency is updating our CEA performance appraisal process to include new measurements for meeting performance objectives in support of the Agency's goals.
Threat: If pay parity is not provided equitably for all Agency classifications, then employee morale may erode, disgruntlement may increase, we may see an exodus of skilled employees leaving for more lucrative jobs, recruitment and retention may be increasingly difficult, products and services may suffer, transportation systems may degrade, and employee misconduct may increase		
Likelihood	Impact	
1	2	

Table C-2. Example of Agency-Level Risk Controls 2

Risk Category: Compensation and Benefits	<p>Control Considerations:</p> <ol style="list-style-type: none"> 1) Does the Organization offer competitive compensation and benefits? Are compensation and benefits aligned with industry standards? Do people leave the employment of the Organization because they are not being appropriately compensated? 2) Are employee titles appropriate to their business levels? 3) How does the Organization ensure that employees' compensation and benefits align to their expectations? 4) How does the Organization ensure that its compensation and benefits program is competitive in the marketplace?
Established Level of Risk: Improve	

Table C-3. Example of Agency-Level Risk Controls 3

<p>Risk Category: Political The Political risk category was identified by the Senior Management Team as the category with the 3rd highest impact to the Agency. It includes risks such as Congressional inaction, inability to pass needed legislation due to polarization of viewpoints, loss of the MHTC form of government, loss of political support, and lack of a compelling vision for transportation.</p>			
<p>Processes to Monitor and Mitigate Risk</p>			
Processes to Monitor and Mitigate Risk	Process Owner	Monitoring/Reporting	Cycle
Existence of Governmental Relations Division with dedicated staff to monitor issues of political concern, educate on behalf of the Agency, and engage the Commission and Agency Management as appropriate	Governmental Relations	Reporting to Commission and Legislative Committee meetings	Ongoing
Use of the Commission funding formula and planning process to de-politicize decision-making	Transportation Planning	Statewide Transportation Improvement Program	Annual
Strong partnerships with stakeholders and industry partners that will lobby on the Agency's behalf	Executive Management	Informal	Ongoing
Congressional visits to promote the importance of transportation	Governmental Relations	Informal	Ongoing
Organized planning efforts such as <i>On the Move</i> to create a transportation vision for the State	Transportation Planning		
Participation in AASHTO, MAASTO and other organizations that support transportation at the national and regional level	Director	Informal	Ongoing
Strong working relationship with FHWA Division Administrator	Executive Management	Informal	Ongoing
<p>Identified Gaps:</p>			
Ability to positively influence transportation funding at the national level			
<p>Note: Bolded strategies have been identified by the management team as those most critical to mitigating this risk.</p>			