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Enterprise Risk Management in State Departments of Transportation

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Enterprise Risk Management in State Departments of Transportation

By

TIMOTHY BRET MCGUIRE

B.A, Virginia Tech 2009

A thesis submitted to the
Faculty of the Graduate School of the
University of Colorado in partial fulfillment
of the requirement for the degree of
Master of Science

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APPROVAL

This thesis entitled:
Enterprise Risk Management in State Departments of Transportation

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Date

The final copy of this thesis has been examined by the signatories, and we find that both the content and the form meet acceptable presentation standards of scholarly work in the above mentioned discipline.

ABSTRACT

McGuire, Timothy Bret (M.S., Civil, Environmental and Architectural Engineering)

Enterprise Risk Management in State Departments of Transportation

Thesis directed by Professor Keith Molenaar and co-directed by Assistant Professors Matthew Hallowell and Amy Javernick-Will

In an effort to increase performance, transparency, resource allocation, and decision-making, United States (U.S.) state departments of transportation (DOTs) are developing and implementing formal enterprise risk management (ERM) programs. To explore ERM performance and help agencies advance their ERM programs, this research investigates and documents the following aspects of DOTs with formal ERM programs: strategic goals and corresponding risks; risk measures; risk controls; and processes in place to identify risks, establish measures, and develop controls. This thesis presents the results of a multi-method research approach that included surveys, interviews, and case study investigations. Surveys were administered to all 52 DOTs, with responses received from 44/52 (85%). Organization-wide ERM implementation was identified at nine agencies and follow-up interviews were conducted with eight of the nine DOTs that indicated formal ERM programs. Additional case study investigations were conducted on six of these interviewed DOTs. This paper presents the synthesized results of four of the six case studies that had documented strategic risks managed through an ERM program. Principal findings include the strategic risk categories and specific strategic risks managed by formal ERM programs, the assessments of these risks, and controls in place to assist the DOTs' efforts to achieve their mission and strategic goals. Accompanying these findings are the corresponding processes used in the

different stages of the investigated risk identification, assessment, and management strategies. The results are intended to serve as a reference tool for DOT executives and senior management as they develop and implement ERM at their own agencies and also to advance the state of knowledge in the transportation research community.

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INTRODUCTION

The strategic goals of an organization exist to guide the organization's efforts of achieving its mission (e.g., allocation of resources and decision-making). Clearly defining the goals is a critical aspect of the organization's overall strategic planning process (Armstrong 1982). Strategic planning for state agencies, as defined by Berry and Wechsler (1995, p. 159), is "a systematic process for managing the organization and its future direction in relation to its environment..." With departments of transportation (DOTs) operating in an environment that is fraught with risk (Molenaar et al. 2010), the effort to achieve the strategic goals, and ultimately the agency's mission, requires members of the organization to have a clear understanding of the strategic goals and corresponding risks to these goals. Strategic risks (also commonly referred to as agency or enterprise risks) are the potential issues that threaten an organization's effort and ability to reach its strategic goals and objectives. As a result of increases in technology and changing business practices, risks facing organizations have increased in quantity, diversity, and complexity (FHWA 2012). Because strategic risks have potential implications on an organization's performance, risk management is a critical aspect of an organization's strategic planning (Andrews 1987).

In response to the evolving environment of risk, and under the impetus of the consideration of risk in the Federal Government's *Moving Ahead for Progress in the 21st Century* (MAP-21), some United States (U.S.) DOTs are developing and implementing formal enterprise risk management (ERM) programs (FHWA 2012). ERM is a risk management approach that penetrates all levels and units of an organization in a holistic fashion to understand all potential consequences of risks. ERM differs from the traditional silo-based approach by managing risks with an enterprise-wide approach (Casualty Actuarial Society 2003). ERM integrates performance and

asset management with strategic planning and focuses on risks that have the potential to impact the agency's performance negatively (FHWA 2012). The enactment of MAP-21, signed into law in July of 2012, requires that each state 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). In addition to MAP-21, other reasons identified for implementing formal ERM programs include: developing an enterprise-wide risk management culture; improving public perception of the organization; enhancing agency governance; responding to changing risk environment; better aligning operations with strategic objectives; and improving consistency in operational performance.

Although ERM will be required in state DOTs, to date, little research has been conducted in the area. Some studies have documented the benefits that can accrue to a transportation agency with ERM (e.g., FHWA 2012). Specifically, a U.S. panel of transportation experts visited transportation agencies throughout Europe, the United Kingdom, and Australia and found nine prominent benefits of formal ERM (FHWA 2012). The benefits identified by the research panel indicate that ERM:

1. Helps make the business case for transportation and building public trust
2. Avoids or minimizes managing-by-crisis and promotes proactive management strategies
3. Explicitly recognizes risks in multiple investment options with uncertain outcomes
4. Provides a broader set of viable solution options earlier in the process
5. Communicates uncertainty and helps focus on key strategic issues
6. Improves organizational alignment
7. Promotes an understanding of the repercussions of failure
8. Helps apportion risks to the party best able to manage them

9. Facilitates good decision-making and accountability at all levels of the organization

This research effort is a systematic investigation of the strategic risks and corresponding measures and controls in place at state DOTs with formal ERM programs. The topic emerged from research being conducted concurrently on the National Cooperative Highway Research Program (NCHRP) research project 8-36 Task 121: *Successful Implementation of Enterprise Risk Management in State Transportation Agencies*. The NCHRP 8-36 (121) project is a joint research effort between the engineering consulting group Parsons Brinckerhoff and a research team at the University of Colorado (CU) Boulder. The CU research team consists of Drs. Keith Molenaar, Matt Hallowell, and Amy Javernick-Will and Timothy McGuire. Tasks for the NCHRP 8-36 (121) project include:

Task 1: Identify DOTs who are using ERM

Task 2: Identify ERM case examples through interviews

Task 3: Recommend case examples

Task 4: Conduct ERM case studies

Task 5: Prepare a report on case studies

This project supplements the previously completed NCHRP project, NCHRP 20-24 Task 74: *Executive Strategies for Risk Management by State Departments of Transportation*, which identified the need to research effective implementation of formal ERM at state transportation agencies. This thesis, *Strategic Risks with Measures and Controls of State Departments of Transportation*, responds to this need by focusing on the management of strategic risks by formal ERM programs at DOTs.

POINT OF DEPARTURE

Although notable benefits of formal ERM programs have been identified, there is not pervasive use or a significant pool of resources for ERM in state DOTs. *The objectives of this thesis are to identify; (1) strategic risks managed by formal ERM programs; (2) corresponding measures and controls for these risks; and (3) processes used to identify, measure, and manage the risks.*

RESEARCH METHOD

To achieve the objectives of this research, a multi-method research approach was used. Figure 1 illustrates the process of conducting the research with the focuses and primary results of each step. The research was sequential and each step intended to further investigate information collected in the previous step.

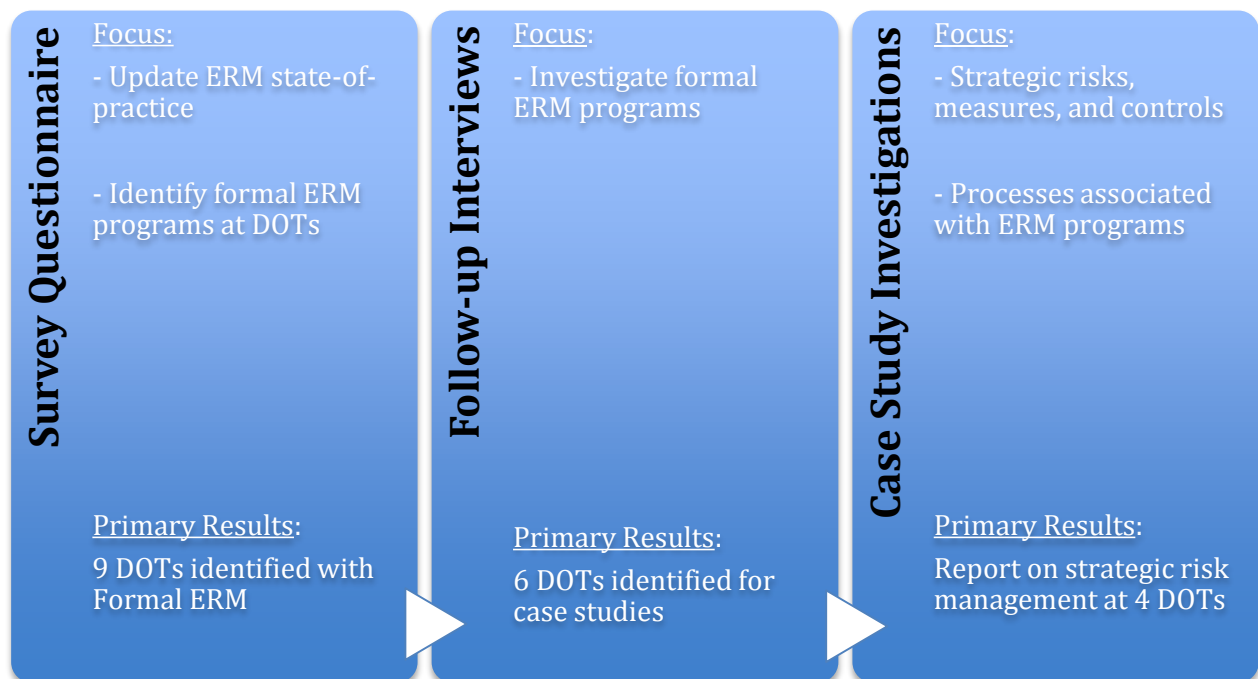


Figure 1. Research Method Process

Survey Questionnaire

Literature from multiple FHWA publications on risk and asset management (FHWA 20120, past surveys regarding ERM usage (Aon 2010), the ISO-31000 Risk Management – Principles and Guidelines (ISO 2009), COSO ERM Framework (COSO 2004), and private sector ERM publications (Meulbroek 2002, Nocco and Stulz 2006) were used to develop a survey questionnaire. The goals of the survey were to benchmark the state-of-practice of ERM at U.S. DOTs, to recognize components of an ERM program that can be considered indicators of ERM maturity, and identify similarities in the ERM programs at different transportation agencies. The survey was distributed to all 52 DOTs and respondents for the survey consisted primarily of senior/upper level individuals. Survey questions related to drivers of the ERM program implementation; how the programs were developed; presence of risk executives, risk registers, and ERM guidebooks at the agency; and how certain risk types are managed at the agency. Survey responses were received from 44 of the 52 DOTs (85%), and formal, organization-wide ERM programs were identified at nine DOTs.

Follow-up Interviews

Individuals who indicated their agency had implemented a formal ERM program or initiatives participated in follow-up interviews to further understand their agency's ERM program. Eight interviews were conducted with management level or higher individuals; many of whom were directly involved with the development and/or operation of the ERM program. The focus of the interviews was on types and sources of agency-level risks managed through the ERM programs, and the ERM processes and responsibilities of individuals at the agency. The Enterprise Risk Management in State Departments of Transportation

development of the interview questionnaire was aided by Oppenheim's questionnaire/interviewing design (Oppenheim 1992). The questions used in the follow-up interviews considered:

- General context of ERM at the agency;
- Identification, assessment, response, and monitoring of agency-level risks;
- Communication of strategic risk management and ERM processes at the agency;
- Lessons learned; and
- Recommended best practices for formal ERM programs.

Case Study Investigations

To continue the research into the ERM programs, an NCHRP panel recommended six DOTs as case studies to investigate: (1) strategic goals and risks; (2) measures of the strategic risks; (3) controls implemented and planned to manage the risks; (4) procedures at the DOT relating to strategic risk identification and assessment; and (5) other aspects believed to be fundamental to an ERM program – e.g., roles and responsibilities, the ERM program's origin and drivers, communication of ERM efforts, and performance measures for the program.

The research ultimately considered the processes for identifying strategic risks, assessing the risks, and establishing controls at the investigated DOTs. It is believed that, due to the current shortage of information relating to the thesis topic, there is a significant need for research into the management of strategic risks by formal ERM programs. The thesis research leveraged the information and data being collected and analyzed for the NCHRP 8-36 (121) research with a goal to provide a series of reports to aid DOTs as they develop and implement their own ERM programs. The data yielded substantial material and information from the DOTs' ERM programs that was analyzed to better understand what strategic risks are managed by formal ERM and how this is

done. The data collected pertained to the strategic risk identification processes and documented risks, the measures for these risks and the assessment processes, the controls in place for the risks, and how the controls were developed.

Research Validity

The validity of this research is of the utmost importance. Several methodological controls were implemented to ensure that the data and results are both valid and reliable. The four validity tests considered are: (1) construct validity; (2) internal validity; (3) external validity; and (4) reliability (Yin 2009). These are reviewed below.

Construct Validity

Construct validity involves establishing the accurate operational measures and descriptors for the elements being studied (Yin 2009). This involved selecting specific aspects of ERM programs to be investigated and then confirming the relationship between the programs and ERM implementation/maturity. For this study, the units of analysis were the ERM processes in place at the DOTs that reveal a mature/maturing ERM program. The processes used in this study were identified from the research conducted by the international risk management scan tour (FHWA 2012), L.K. Meulbroek's (2002) research on integrated risk management, the COSO ERM framework (COSO 2004), the ISO-31000 Risk Management – Principles and Guidelines (ISO 2009), and maturity indicators adapted from Aon Corporation's Global ERM survey (Aon 2010).

To ensure appropriate construct validity, the work must indicate that maturity is revealed by consistencies in the processes identified in the ERM programs at different DOTs. Multiple sources of data were used to establish construct validity, and similar characteristics were identified

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during the survey and interview portions of the research. One example of the similarities identified through the interviews was the presence of risk identification workshops. All respondents indicated that their agency conducts formal workshops to identify strategic risks. This indication shows the common process of risk identification in mature/maturing ERM programs.

Internal Validity

Internal validity involves establishing relationships amongst certain conditions that will lead to additional circumstances (Yin 2009). In this research the specific conditions are the processes (identifying strategic risks, measures, and controls) within the ERM program and how the presence of these processes indicates mature/maturing ERM programs. By identifying patterns in the processes and programs at the different DOTs, indicators of mature ERM programs of DOTs can be confirmed.

External Validity

External validity involves establishing the extent to which the findings of the research can be generalized to a larger population. A cross-case comparison was performed across six separate state DOTs. Similarities were found from pattern matching that suggested generalization across transportation agencies. The pattern matching considered the strategic goals of the agencies, risks and risk categories managed, assessment practices, and processes for establishing controls of strategic risks. The consistencies identified in the ERM programs at the DOTs are expected to support the belief that the results could be expected at other transportation agencies.

Reliability

Reliability involves establishing a procedure that will be followed during the case studies that, if repeated in the future, would result in similar findings. For this research, a case study protocol was developed to guide the study. The protocol contains all material related to the case studies to allow for consistency when performing the multiple case studies of ERM programs at DOTs. To increase the reliability of the case studies, a database was used to maintain organization of data gathered through the investigations. The case study database contains: (1) Topics; (2) Questions; (3) Responses; (4) Data Collection Sources; and (5) Data Collection Methods. A copy of the case study protocol matrix can be found in Appendix A.

READER'S GUIDE

The product of this research is a series of in-depth reports that can be used to aid DOT personnel in ERM process development and allow the agency to realize the benefits made possible through ERM. This thesis is comprised of three primary topics intended to serve as sources of information on current ERM practices at DOTs. The three topics address the following aspects of ERM at state transportation agencies: (1) Strategic goals and risks; (2) Measures for the risks; and (3) Controls to manage the risks. Included with each topic are the processes associated.

Along with the research, a tool was developed to aid the management of strategic risks. The tool is a spreadsheet assembled from the analysis of ERM related documents and processes identified at the agencies with formal ERM programs. The spreadsheet includes features of the identification, assessment, and establishment of controls for strategic risks. The elements documented for each strategic risk are:

Identification

- Risk Number
- Risk Statement
- Risk Type
- Risk Group
- Risk Category
- Impacted Strategic Goal
- Impacted Area(s)
- Risk Trigger

Qualitative Assessment

- Likelihood of Occurrence
- Impact
- Controls in Place

Quantitative Assessment

- Likelihood Score
- Impact Score

- Level of Risk (Likelihood Score x Impact Score)

Controls

- Risk Response
- Action(s) Taken
- Action(s) Planned
- Identified Gaps in Ability to Manage Risk
- Owner(s) of Control Effort
- Roles and Responsibilities
- Resources, Equipment, Training Needed to Manage
- Monitoring, Communication, Reporting Procedure(s)
- Performance Measures
- Results of Management Effort

The list of elements to document is extensive, but it is believed to be effective in thoroughly documenting the management process for risks that threaten an agency's efforts to reach its mission and achieve the strategic goals. A copy of the spreadsheet is included in Appendix B.

STRATEGIC GOALS AND RISKS

The synthesis of the strategic goals, risks to these goals, and processes used to identify these risks are presented within this section. Each case study investigation is presented separately and commonalities, uniqueness, and trends are discussed in the conclusion.

Strategic Goals

To better understand the reasoning behind the strategic risks managed by ERM programs, the research first identified the strategic goals of the DOTs. This allowed classification of the goals into high-level categories and then evaluation of the risks by the specific categories. Four of the agencies were found to have strategic goals that were representative of the overall responses. Three of the four DOTs had their strategic goals separated into categories and clearly defined; the other stated these goals as the agency's *Tangible Results*. The respondent from the DOT using *Tangible Results* was consulted to determine how the results were classified to help identify consistencies across the goals. An aggregated list of the strategic goals for DOTs with formal ERM programs is presented in Table 1.

Table 1. Strategic Goals of DOTs Used in Case Study Investigations

Agency	Strategic Goals
Agency #1	<p>Safety – Provide the safest transportation system in the nation for users and workers.</p> <p>Mobility – Maximize transportation system performance and accessibility.</p> <p>Delivery – Efficiently deliver quality transportation projects and services.</p> <p>Stewardship – Preserve and enhance the state's resources and assets.</p> <p>Service – Promote quality service through an excellent workforce.</p>
Agency #2	<p>Safety – Work with unwavering commitment to maximize the safety of the public and employees.</p> <p>Customer Service – Deliver superb service that both anticipates and responds to customer needs.</p> <p>Employee Engagement – Maintain a work environment that is diverse, challenging, and accommodating.</p> <p>Fiscal Responsibility – Invest and manage public funds and other resources wisely.</p> <p>Innovation – Pursue constant improvement in our work and services.</p>

Agency #3	<p>Safety – Keep customers and ourselves safe. Asset Management – Keep roads and bridges in good condition. Customer Service – Provide outstanding customer service. Delivery – Deliver transportation solutions of great value. Mobility – Operate a reliable and convenient transportation system. Efficiency – Use resources wisely. Economic Prosperity – Advance economic development.</p> <p>Note: Agency #3 uses <i>Tangible Results</i> instead of goals. Categorization was aided by the agency contact.</p>
Agency #4	<p>Safety – To provide for and improve the safety and security of transportation customers and the transportation system. Preservation – To maintain, preserve, and extend the life and utility of prior investments in transportation systems and services. Mobility (Congestion Relief) – To improve the predictable movement of goods and people throughout the state. Environment – To enhance the state’s quality of life through transportation investments that promote energy conservation, enhance healthy communities, and protect the environment. Stewardship – To continuously improve the quality, effectiveness, and efficiency of the transportation system. Economic Vitality – To promote and develop transportation systems that stimulate, support, and enhance the movement of people and goods to ensure a prosperous economy.</p>

Strategic Risks

Once the strategic goals were identified, the strategic risks were then collated and analyzed. Each agency’s ERM program, drivers, process, and risks are presented below before the results are synthesized.

Agency #1

The ERM program in Agency #1 was formally implemented in February 2013 with the establishment of the department’s Office of Enterprise Risk Management. Using ISO - 31000 Risk Management – Principles and Guidelines (ISO 2009) as guidance and researching other transportation agencies with established ERM programs, the agency implemented its ERM program with a top-down approach including strong support from the executive members of the agency.

ERM Program Drivers

Drivers for the ERM program identified from the survey response of Agency #1 included:

- MAP-21 requirement;
- ERM successes observed at other agencies;
- Effort to develop enterprise-wide risk management 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; and
- Response to changes in business community – best practices.

Strategic Risk Identification Process

Executives, senior management, and key staff from each district and program performed strategic risk identification in workshops facilitated by managers from the Office of ERM and managers from the Audits and Investigations department. Using a combination of brainstorming and expert interviews, participants were asked to openly identify risks to the agency's strategic goals and values by writing risks in a manner such as "if X happened, Y may occur." Expert interviews were used when an individual could not attend the brainstorming sessions but had valuable information to provide to the identification. According to the agency representative, the result of the risk identification workshop was a list of 999 risks. Using modified affinity analysis to distill the risks, the group established 15 categories of strategic risks to strategic objectives. The 15 categories and a description of each can be seen in Table 2. The strategic risk identification is

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expected to occur every other year with risk assessment conducted in years when risk identification does not occur.

Table 2. Strategic Risk Categories and Description for Case Study Agency #1

Strategic Risk Category	Risk Category Description
Develop Our Workforce	With over half of the employee population at or above retirement age, our agency could suffer significant loss of institutional knowledge.
Develop Shelf Ready Projects and Project Initiation Documents	Given our current economic climate, our agency is unable to plan and design projects without committed funding.
Enhance Communication to Improve Reputation	Our agency has successfully completed many projects that could be positively conveyed to the public and partners.
Engage and Support Employees	Our employees need to perceive the value of their contributions to the department.
Ethical Employees and Strong Performance Management	A small segment of the employee population has behaved unethically. Employees need additional training in ethical behavior, and prompt disciplinary actions for unethical conduct.
Financial Risks from External Mandates	External pressures may challenge the agency's ability to fulfill its mission and vision.
Flexibility in Environmental Stewardship	Cumbersome mandated procedures and limited resources make the environmental review process challenging.
Foster Partnerships	Our agency strives to build mutual cooperation and shared responsibility for the achievement of specific transportation projects.
Increase Equipment and Vehicle Availability	Our agency could increase efficiencies by using a centralized management system for equipment and vehicles, and obtaining new vehicle technology.
Innovative Information Technology	Continued lack of current technology hampers our agency's ability to optimally realize our goals
Reinvent Our Culture	Our organizational culture can be strengthened to encourage communication, partnerships, and reputational growth.
Strategic Cell Phone Deployment	Limited number and distribution of cell phones may affect our ability to optimally realize its delivery and safety goals.
Streamline the Project Delivery Process	Our focus on delivery may impact other critical departmental functions.
Strengthen Contract and Procurement Processes	Our agency's contract and procurement process should be bolstered to increase controls and contract manager timing.
Support Skilled and Ethical Supervisors	Our agency should strengthen supervisor skill sets to ensure comprehensive enforcement of policies and standard operating procedures.

By having the workshop attendees write formal risk statements, Agency #1 has developed threats and opportunities for each of the 15 risk categories and documented the potential impacts to goals and values. Examples of these risk statements are:

- **Develop Our Workforce Threat:** If our agency does not actively engage in knowledge transfer, including providing good cross training opportunities, then institutional knowledge may be lost and employees may not have the confidence, knowledge or skill to perform their jobs. Impacted Goals and Values: Professional Workforce, Innovation, Commitment, Teamwork, and Stewardship.
- **Financial Risks from External Mandates Opportunity:** If our agency received adequate funding, then we may be able to deliver mandates and maintain our system with fewer delays; relationships with stakeholders may improve. Impacted Goals and Values: Safety, Delivery, System Performance, Teamwork, Stewardship, Commitment
- **Flexibility in Environmental Stewardship Threat:** If our agency does not responsibly streamline the environmental process, then we may suffer project delivery delays, escalating project costs, increase inefficiencies, increase litigation, and diminished local partnerships. Impacted Goals and Values: System Performance, Delivery, Stewardship, Commitment, Teamwork
- **Increase Equipment and Vehicle Availability Opportunity:** If our agency embraced new roadway technology in surveys, traffic management, and other functions, then we could collect more accurate data; minimize employee presence on the roadways, reducing exposure to errant motorists, which may result in fewer injuries and fatalities; and allow employees to be utilized in other work areas. Impacted Goals and Values: Safety, System Performance, Commitment

Agency #2

In June of 2013, the ERM program at Agency #2 was developed and implemented. Using the COSO ERM Framework (COSO 2004) and assistance from an outside consultant, the agency's Director of Audit Operations spearheaded the effort to implement ERM.

ERM Program Drivers

The drivers of the decision to develop and implement a formal ERM program at Agency #2 included:

- 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;
- Response to changing risk environment;
- Better alignment of operations with strategic objectives;
- Past experience of the risk champion with ERM and ERM implementation; and
- To identify and rank risks for internal audit planning and operational decision-making.

Strategic Risk Identification Process

Strategic risk identification at Agency #2 consisted of workshops of senior management (director level and up) who represented the different departments and units of the agency. The workshops were facilitated by the Director of Audit Operations and were conducted in a question-and-answer process regarding what risks the workshop participants believed the department faces. During the brainstorming, individuals were encouraged to explore how the risks affect each area Enterprise Risk Management in State Departments of Transportation

of the organization and the relationships between the risks' effects. The outside consultant provided a survey tool used to fill out the risks and then later to rank/prioritize the risks. The identified risks were aggregated and sorted by the four categories recommended in the COSO framework: Strategic, Operations, Compliance, and Financial. Categorizing and grouping the risks in this manner was done, according to the agency contact, to identify what areas are affected at the highest level (COSO 2004). It also provided insight into how the risks relate throughout the different areas of the organization. The schedule for risk identification is expected to be yearly to recognize which, if any, of the risks have expired and what new risks the agency faces. The result of the strategic risk identification workshop was 62 risks facing the organization. The top 20 risks of the agency are provided below in Table 3 with the corresponding categories.

Table 3. Top 20 Strategic Risks and Risk Categories for Agency #2

Risk Rank	Risk Name	Risk Group: Risk Category
1	Recruiting and retention	Operations: People/Human Resources
2	Compensation and benefits	Operations: People/Human Resources
3	Staffing levels	Operations: People/Human Resources
4	Succession planning	Operations: People/Human Resources
5	Technology enablement and technology implementation	Strategic: Planning and Resource Allocation
6	Annual budgeting and forecasting	Strategic: Planning and Resource Allocation
7	Critical infrastructure, PP&E	Operations: Physical Assets
8	Third-party relationships	Strategic: Planning and Resource Allocation
9	Core service delivery	Operations: Supply Chain
10	Procurement, including materials planning and forecasting, and inventory management	Operations: Supply Chain
11	Development and performance	Operations: People/Human Resources
12	Labor relations	Operations: People/Human Resources
13	Public relations	Strategic: Communication and Stakeholder Relations
14	Fraud, waste, and abuse	Compliance: Code of Conduct
15	Strategic planning	Strategic: Planning and Resource Allocation
16	Culture	Operations: People/Human Resources
17	IT availability/continuity	Operations: Information Technology
18	Terrorist and malicious acts	Operations: Hazards
19	Funding	Financial: Liquidity and Credit
20	Decision support	Operations: Information Technology

Agency #3

Information provided by the contact at Agency #3 indicated the ERM program was implemented in the summer of 2013. The COSO framework was referenced in the development of the ERM program. While there is no staff dedicated specifically to the ERM program at this agency, the ERM efforts at the agency are championed by the agency's Chief Financial Officer (CFO).

ERM Program Driver

The decision to develop and implement a formal ERM program at Agency #3 was driven by an effort to enhance agency governance, specifically by a desire for good governance from the commission level of the agency.

Strategic Risk Identification Process

Identification of strategic risks was performed in workshops with a senior management team and facilitated by the Agency's CFO. The senior management team consisted of the district engineer from each of the agency's seven districts and the division head from each of the 24 divisions of the agency. The discussion considered what they were trying to achieve as an agency and what things could prevent success. The senior management team then spent time identifying risks and the CFO took the identified risks and distilled them into 10 strategic risk categories with specific examples of risks for each category. The CFO stated that the strategic risk identification is to be an annual process, along with the risk assessment and establishment of risk controls. Table 4 displays the 10 strategic risk categories of the agency and examples of strategic risks to the categories.

Table 4. Top 10 Strategic Risk Categories and Examples of Agency #3

Risk Category	Strategic Risk Examples
Financial	<ul style="list-style-type: none"> • Uncertainty of federal funds • Viability of fuel tax as a revenue source • Unstable economy • Inability to match federal funds • Inflation in commodities and/or contract prices • Benefit costs
Public Opinion/Support	<ul style="list-style-type: none"> • Loss of reputation • Lack of understanding of cost of building/maintaining infrastructure • General mistrust of government
Political	<ul style="list-style-type: none"> • Congressional inaction • Inability to pass legislation due to polarization of viewpoints • Loss of commission form of governance • Loss of political support • Lack of a compelling vision for transportation
Work Force	<ul style="list-style-type: none"> • Significant turnover in key personnel • Significant turnover at the Senior Leadership Team level • Existence of single points of failure • Poor morale • Loss of trust/One Team Culture • Insufficient number of potential employees in the pipeline in the skill areas we'll need
Legal and Regulatory Changes	<ul style="list-style-type: none"> • Unfunded mandates • Prescriptive federal rules and regulations • Binding arbitration • Unfavorable state legislation such as increased truck weights and revenue diversions
Major Transportation System Failure	<ul style="list-style-type: none"> • Bridge collapse • Major interstate condition and capacity • System gridlock in metro areas
Natural Disaster	<ul style="list-style-type: none"> • Earthquake • Blizzard • Flooding • Tornado • Pandemic • Nuclear power plant event
Information Technology	<ul style="list-style-type: none"> • System failure • System destruction • Hacking • Cyber-terrorism
Safety/Security	<ul style="list-style-type: none"> • Workplace violence • Terrorist act
Fraud/Theft	<ul style="list-style-type: none"> • Theft of equipment/supplies • Theft of financial resources • Fraud by sub grantees/sub recipients

Agency #4

The ERM program in place at Agency #4 stemmed from the Agency's project-level asset risk management and grew with a supportive push from the agency's Secretary and the Governor's desire to move to formal ERM across the entire organization. In 2009, the Agency developed the ERM policy statement and senior members developed the framework currently in place. According to information accessed in the case study investigation, the individuals that developed the ERM program at Agency #4 referenced the ERM program in place at New South Wales Transportation Agency but made modifications to better fit the strategic needs of the agency. The draft framework was then reviewed and approved by the agency's executives. The strategic risk categories used at by the Agency's ERM program were decided upon based on the areas where many agency-level risks were observed. The categories correlate very closely to the department's strategic plan and can therefore be mapped back to the strategic objectives.

ERM Program Drivers

Drivers for implementing ERM at Agency #4 include:

- 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 objectives; and
- Better assessment of risk across boundaries to improve tradeoff analysis.

Strategic Risk Identification Process

Strategic risk identification was conducted through separate workshops with directors of divisions and teams of individuals from the corresponding divisions. The risk identification workshops were typically facilitated by representatives from the Department of Enterprise Risk and Safety Management; ideally the Department Director and Safety Program Risk Manager. The workshops consisted of a brief training and informational session to inform the participants on risk management and how risks can affect the Agency's strategic plan. The participants then brainstormed to identify strategic risks and develop formal risk statements. Strategic risk identification workshops at Agency #4 occur on an on-going basis rather than a yearly schedule. Table 5 provides a list of the Agency's strategic risk categories with a brief description.

Table 5. Strategic Risk Categories and Descriptions of Agency #4

Risk Category	Risk Category Description
Credibility	The reputation and level of trust earned by the agency from the public, the legislature, the governor, and other agencies to carry out its mission and meet its commitments of delivering the programs, projects, and services entrusted to it.
Transportation System Performance	The functional performance of all the transportation system modes and services within the responsibility of the agency, including highway, ferry system, freight, and rail mobility, modal infrastructure preservation, maintenance, and operations.
Departmental Performance	The functional performance of all the transportation system modes and services within the responsibility of the agency, including highway, ferry system, freight, and rail mobility, modal infrastructure preservation, maintenance, and operations.
Environmental	Agency stewardship of the environment and natural resources within the agency's control and impact, including wetlands, bodies of water, fish and wildlife and their habitat, and vegetation.
Financial	Agency's fiscal responsibility to expend funds within the scope of inter and budget provided by the legislature and signed by the governor for all programs, projects, and services.
Health and Safety	The physical wellbeing of agency employees, users of the State transportation system, and property owners with respect to death, disease, bodily injury, and property damage.
Legal and Compliance	Agency's ability to comply with all federal, State, and departmental laws, regulations, and policies.
Critical Support Resources	Departmental resources that are necessary to carry out the core functions of the department, including: information technology systems and technology; data collection, storage and management; materials and laboratory services; and geotechnical services.

Strategic Risk Measures

Due to the potential implications that strategic risks can have on an organization's performance, management of these risks is a critical aspect of an organization's strategic planning (Andrews 1987). Assessing or measuring these risks is, therefore, a critical part of the risk management process and occurs once risks have been identified and documented. Several reports and ERM frameworks exist to aid the process of assessing risks (e.g., ISO-31000, COSO ERM Framework). Information relating to assessment practices within those documents is presented to provide a baseline for what is required for appropriate risk assessment. The research then investigates the actual processes in place at the case study DOTs to identify how these agencies implemented and adapted processes to measure and assess risks in the context of their ERM programs.

Risk Management Frameworks

The International Standards Organization (ISO)-31000 Risk Management – Principles and Guidelines suggests succeeding the risk identification process by evaluating and ranking risks (ISO 2009). The framework recommends using an established protocol or template to document relevant information regarding the risk to transfer the information into a risk register or similar tool. It is important to have predetermined definitions and levels to assess the risks' likelihood and consequence that consider the agency's risk tolerance. The ranking of the risks can be performed in a variety of ways according to the ISO-31000 guide – quantitative, semi-quantitative, or qualitative. Table 6 illustrates the items suggested for inclusion in the risk documentation and a brief description. The ISO-31000 guide states that agencies should define their own measures or scales for assessing the likelihood and consequence of the risks. The measures can be qualitative

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in a 3 x 3 matrix of low, medium, high manner or the agency may require a system with more options such as a 5 x 5 qualitative matrix. Further analysis of the risks like ranking or prioritizing is made possible by understanding the risks' likelihood and consequence (ISO 2009).

Table 6. Risk Elements to Record When Establishing Measures (Source: ISO-31000)

Element to Document	Description of Element
Name or title of risk	Unique identifier or risk index
Scope of risk	Scope of risk and details of possible events, including description of the events, their size, type, and number
Nature of risk	Classification of risk, timescale of potential impact and description as hazard, opportunity, or uncertainty
Stakeholders	Stakeholders, both internal and external, and their expectations
Risk evaluation	Likelihood and magnitude of even and possible impact or consequences should the risk materialize at current level
Loss experience	Previous incidents and prior loss experience of events related to the risk
Risk tolerance, appetite, or attitude	<ul style="list-style-type: none"> • Loss potential and anticipated financial impact of the risk • Target for control of risk and desired level of performance • Risk attitude, appetite, tolerance or limits for the risk
Risk response, treatment and controls	<ul style="list-style-type: none"> • Existing control mechanisms and activities • Level of confidence in existing controls • Procedures for monitoring and review of risk performance
Potential for risk improvement	<ul style="list-style-type: none"> • Potential for cost-effective risk improvement or modification • Recommendations and deadlines for implementation • Responsibility for implementing any improvements
Strategy and policy developments	<ul style="list-style-type: none"> • Responsibility for developing strategy related to the risk • Responsibility for auditing compliance with controls

The COSO ERM framework discusses assessing risks by two evaluations: likelihood and impact (COSO 2004). The purpose is to establish the extent to which the risks can affect an organization's ability to reach its goals and objectives. Identifying and considering interrelationships between a risk's likelihood and impact are the responsibility of management and COSO suggests using interviews or workshops to assess likelihood and impact. Once the internal and external factors that present potential risks have been established, the COSO framework Enterprise Risk Management in State Departments of Transportation

recommends considering both the positive and negative effects for all aspects of the organization if the potential risks were to be realized. Assessing the risks and establishing measures is comprised of qualitative and quantitative techniques. Qualitative assessment is commonly used when a risk is difficult to assess quantitatively such as when there is insufficient information to perform a quantitative assessment or a quantitative assessment is believed to not be cost-effective. When compared with qualitative methods, assessing a risk *quantitatively* requires increased precision and is more suitable as a supplemental assessment for complex risks. Examples of quantitative assessment techniques include:

- Benchmarking – developing datasets on events, processes, and measures to assess likelihood
- Probabilistic models – using certain assumptions aided by historical data to associate a range of events and impacts with the events' likelihood
- Non-probabilistic models – using subjective assumptions to estimate an event's impact without quantification of the likelihood

The ISO-31000 Risk Management – Principles and Guidelines (ISO 2009) and COSO ERM Framework (COSO 2004) provide guidance on risk assessment techniques that were identified in the risk management practices of the investigated agencies. The specific risk assessment techniques and resulting measures for the four agencies are presented and discussed on a case-by-case basis before being analyzed in the conclusion.

Measures and Assessment Processes Identified

Measures for strategic risks were identified at three of the four DOTs used in the case studies. Measures for Agency #4 were currently being established at the time of this research, therefore making them unavailable for inclusion. However, the processes used to establish the strategic risk measures were documented for each of the four agencies. Examples of the risk measures developed for Agencies #1 and #3 are included in their respective sections to demonstrate the outputs of the Agency's strategic risk assessment process. A full list of assessments for strategic risks for Agency #1, #2, and #3 can be found in Appendices C, D, and E, respectively.

Agency #1

Risk measures for strategic risks are established every other year at Agency #1. Participants of the risk assessment included executives, senior management, and key staff from each of the agency's programs that participated in the strategic risk identification workshops. Managers from the Agency's Office of Enterprise Risk Management and managers from the Audits and Investigations division facilitated the risk assessment process. For each strategic risk, the representatives from the respective programs considered likelihood of occurrence, impact if the risk is realized, and controls currently in place. Once the controls in place were identified, the individuals rated and documented the likelihood and impact of each risk using a three-point scale. According to the Agency representative, a three-point scale was used to assess likelihood and impact because of its simplicity and because it was less mathematically challenging to assess. The representative stated, "If you want everyone to get it at a strategic level, you want it to be easy to understand and efficient." The agency believed that making the risk management process of ERM

understandable was a key to the success of the program. Risks that were identified by multiple divisions or programs and rated with high likelihood and impact were also analyzed.

Agency #1 considers strategic risks as both opportunities and threats and the assessment procedures were the same for both types of risks. Table 7 illustrates a sample output of the assessment process for one strategic risk category of the agency – *Engage and Support Employees*. Each threat and opportunity for the 15 strategic risk categories of Agency #1 was assessed in a similar fashion. The assessment results for all 15 strategic risk categories can be found in Appendix C.

Table 7. Sample Output of Establishing Risk Measures at Agency #1

Engage and Support Employees	Likelihood	Impact
Threat #1: 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.	1	2
Opportunity #1: If all employees feel that their contribution to the Department is valuable, then employee motivation may increase, employee morale may improve, employee retention may increase, and work products and services may improve.	3	2
Opportunity #2: If the Agency improved communication practices between management and staff, then the Agency may implement priorities more consistently, employee participation and engagement may improve, morale may increase, and engaged employees would produce a higher quality of work.	2	3
Opportunity #3: If the Agency revised its IDP form and process to be less cumbersome to complete, allow for focused evaluations for specific skills or classifications, and provide regular, meaningful, performance feedback to employees, then the Agency may see an increase in employee skill, work output and morale, and products and services may improve.	2	2

Agency #2

Agency #2 used an outside consultant to aid the risk identification process and to assist with the establishment of measures corresponding to the identified strategic risks. The senior management group, which consisted of individuals at a director level and up, represented the Enterprise Risk Management in State Departments of Transportation

different units and departments of the Agency, and worked with the consultant group to establish the risk measures. The Agency used a survey tool to rank the risks, and then assessed the risks by impact, likelihood, and level of management control. Using a heat map with four quadrants that plotted a risk's inherent value (impact score x likelihood score) and level of management control, the senior management team was able to assess and classify the top 20 strategic risks of the Agency by four different classifications: Improve, Monitor, Accept, Optimize.

Inherent risk value was calculated by multiplying each risk's estimated likelihood score and impact score. This calculation provided each risk's essential value, hence referring to it as an inherent value. Tables 8, 9, and 10 provide the scoring criteria with associated ratings that are used in assessing agency-level risks and establishing measures at the Agency. According to the contact used throughout the research, the development of these ratings was aided by the outside consultant group and based on how the Agency wanted to measure risks. While conducting the case study investigation on Agency #2, the contact stated that the establishment of risk measures is expected to occur annually as yearly strategic risk identification workshops occur. Figure 2 (Appendix D) illustrates the results of plotting the top 20 strategic risks at Agency #2 on a heat map containing the four classification levels. The contact at Agency #2 explained that these classification levels allow for better understanding and prioritization of internal audit focus and determination of a risk response.

Table 8. Agency #2 Scoring Criteria: Impact

Criteria – Impact			
SCORE	RATING	DURATION	DESCRIPTION
5	Critical	Recovery in more than 12 months or irrecoverable	Inability to achieve business objectives, e.g.: <ul style="list-style-type: none"> • Critical or complete loss of business capacity • Excessive costs critically impacting long-term profitability and viability • Inability to retain a portion of customers/inability to attract new customers • Significant operational losses leading to significant reduction of market value

4	High	Recoverable in long term (6-12 months)	<p>Reduced ability to achieve business objectives, e.g.:</p> <ul style="list-style-type: none"> • Significant reduction in service and business capability • Incurring excessive costs that significantly impact current earnings and profitability • Loss of misappropriation of significant assets • Loss of significant number of key personnel
3	Moderate	Recoverable in short term (3-6 months)	<p>Moderate impact to achievement of business objectives, e.g.:</p> <ul style="list-style-type: none"> • Loss of high value customers or alliances, customer loyalty and sales opportunities • Temporary loss of service or business capability • Temporary but recoverable reduction in credibility/reputation • Short-term increase in costs or loss of revenue
2	Low	Temporary	<p>Limited impact on achievement of business objectives, e.g.:</p> <ul style="list-style-type: none"> • Short-term or limited reputation damage • Limited impact on customer retention • Limited increase in costs • Minimal impact to revenue or earnings
1	Minor	Relatively insignificant impact on the achievement of business objectives	

Table 9. Agency #2 Scoring Criteria: Likelihood

Criteria - Likelihood			
SCORE	RATING	PROBABILITY	FREQUENCY
5	Expected	> 90%	Yearly
4	Highly Likely	≤ 90%	Every 1-2 years
3	Likely	≤ 60%	Every 3-5 years
2	Not Likely	≤ 30%	Every 6-9 years
1	Slight	≤ 10%	Every 10 years and beyond

Table 10. Agency #2 Scoring Criteria: Level of Management Control

Criteria – Level of Management Control		
SCORE	RATING	DESCRIPTION
5	Effective	Control properly designed and operating as intended
4	Limited Improvement Needed	Control properly designed and operating with opportunities for improvement identified
3	Significant Improvement Needed	Key control in place with significant opportunities for improvement identified
2	Ineffective	Limited control in place; high level of risk remaining
1	Highly Ineffective	Control nonexistent or major deficiency identified; control not operating as intended

Agency #3

At Agency #3, the Senior Management Team that identified the agency's strategic risks also developed the corresponding risk measures. The Senior Management Team consisted of: the district engineer from each of the seven districts and the division head from each of the 24 divisions at the agency. To develop the levels to measure the risks – Readiness, Likelihood, Impact – the Agency's ERM champion researched the COSO ERM framework. Using the likelihood and impact recommended by the COSO framework, and adding a Readiness measure, the team evaluated each of the risks categories on a four-point scale. The averaged measured values were then used to rank the risk categories.

In the case study investigation, the contact at Agency #3 indicated that a four-point scale was used because it was believed to be practical and would prevent the individuals assessing the risks from having the opportunity to select a middle value that would be available in a three-point or five-point scale. Each member of the team recorded their own measures for each risk individually and returned the assessments to the ERM champion. The responses were then averaged to generate the values seen in Appendix E. According to information provided by the Agency contact during the investigation, there is currently not a set schedule for when the risk measures will be reevaluated, but it is expected to be a process that will occur annually.

Table 11 illustrates the assessment of a specific risk category at Agency #3. The highlighted value indicates the averaged risk measures developed by the Senior Management Team.

Table 11. Sample Output of Establishing Risk Measures at Agency #3

Strategic Risk Category	Readiness				Likelihood				Impact						
	Plans in Place<----->Unprepared				Little Chance<----->Fairly Certain				Little Impact<----->Devastating						
Political	1	2	2.6	3	4	1	2	2.7	3	4	1	2	3	3.1	4

Agency #4

Establishing measures for strategic risks at Agency #4 involved the individuals that also participated in the workshops to identify the strategic risks. Representatives from the Department of Enterprise Risk and Safety Management at the Agency facilitated the establishment of risk measures. The measures were developed through a two-phase process that included an evaluation and an analysis of each risk. The risk evaluation involves determining the severity (consequence) if the risk was to be realized and the likelihood of occurrence. For each of the eight categories of strategic risks at the Agency, a scale was developed to score risk severity. Table 12 illustrates the scale used and the severity levels for each category. The risk evaluation phase of the assessment then scored each risk by level of likelihood using the scale that can be seen in Table 13. Each member of the team established a level of severity score and a level of likelihood score for each risk. The scores were then tallied and averaged values were given to each risk.

Table 12. Risk Severity Scale Developed and Used by Agency #4

Risk Category	Severity Scale
Credibility	<ol style="list-style-type: none"> 1. Minimal – Isolated local community or individuals issue-based concerns 2. Minor – Local community impacts and concerns; occasional single negative media report 3. Moderate – Regional community impacts and concerns publicly expressed with negative media for days 4. Significant – Prolonged community impact with dissatisfaction publicly expressed; Community loss of confidence and negative media for weeks 5. Major – Constant extreme negative media for months; Irreconcilable community loss of confidence; Prolonged Legislature or Federal Intervention
Transportation System Performance	<ol style="list-style-type: none"> 1. Minimal – Lifelines unaffected 2. Minor – Short delays and operational slowdowns that go unnoticed 3. Moderate – Lifelines open but vulnerable 4. Significant – Lifelines cut off for an extended time 5. Major – Permanent damage to multiple interstate systems cutting off lifelines
Departmental Performance	<ol style="list-style-type: none"> 1. Minimal – Impact managed through routine activities 2. Minor – Impact requires additional consultant effort or redirection of resources to respond 3. Moderate – Impact requires management and resources from one or more divisions to respond 4. Significant – Impact requires significant long-term management and resources, and Secretary of Transportation intervention 5. Major – Impact cannot be managed within Agency existing resources; Threatens agency survival; Requires Governor or Legislation

Environmental	<p>1. Minimal – Permanent damage or impact to plants and animal species extending over a wide area affecting most of the state</p> <p>2. Minor – Pervasive and sever temporary damage extending over a large area requiring extensive and lengthy remediation, and years of recovery</p> <p>3. Moderate – Severe temporary damage extending over a large area requiring extensive remediation with damage recoverable</p> <p>4. Significant – \$ effect is \$1 million to \$10 million</p> <p>5. Major – \$ effect is more than \$10 million</p>
Financial	<p>1. Minimal – \$ effect less than \$10,000</p> <p>2. Minor – \$ effect is \$10,000 to \$100,000</p> <p>3. Moderate – \$ effect is \$100,000 to \$1 million</p> <p>4. Significant – \$ effect is \$1 million to \$10 million</p> <p>5. Major – \$ effect is more than \$10 million</p>
Health and Safety	<p>1. Minimal – Incident with or without minor injury requiring first aide</p> <p>2. Minor – Injuries requiring first aide</p> <p>3. Moderate – Injuries requiring medical treatment</p> <p>4. Significant – Injuries requiring hospitalization</p> <p>5. Major – Fatal or permanent disabilities</p>
Legal and Compliance	<p>1. Minimal – Legal issues managed by routine procedures</p> <p>2. Minor – Complex legal issues to be addressed</p> <p>3. Moderate – Serious incident that requires investigation or a lawyer to decide liability</p> <p>4. Significant – Major litigation</p> <p>5. Major – Class action lawsuit; significant prosecution and fines</p>
Critical Support Resources	<p>1. Minimal – Requires use of overtime for less than 3 months</p> <p>2. Minor – Requires use of overtime for a limited time or use of consultant/special services without an increase in cost</p> <p>3. Moderate – Requires over 3 months of overtime or use of consultant/special service with small increase in cost</p> <p>4. Significant – A consultant or special service must be used with considerable increase in cost</p> <p>5. Major – Agency expertise, Consultant, and Special Services are not available or cost is prohibitive</p>

Table 13. Level of Likelihood Scale Developed and Used by Agency #4

Levels of Likelihood	
1 --- Very Unlikely	Mostly likely will not happen or could happen less than once in 10 years
2 --- Unlikely	Low likelihood or could happen about once in 10 years
3 --- Possible	Less than a 50/50 chance or could happen about once in three years
4 --- Likely	About a 50/50 chance or could happen about once a year
5 --- Very Likely	Greater than a 50/50 chance or could happen several times per year

The second phase of establishing measures for the strategic risks involved using the averaged severity and likelihood scores to plot the risks on a heat map. Plotting the risks on a heat map provided the team with a level for each risk. The level of risk indicated the risk's priority level by taking into account the required levels of management, severity, and likelihood. Ownership of

the risk was also indicated by a risk's level of severity. Table 14 describes the four levels of risk and potential consequences associated with the risk levels.

Table 14. Levels of Risk Developed and Used by Agency #4

Levels of Risk	Description of Associated Consequences
1. Very High (Red)	For risks, the consequences impact the continuation of the Department and possibly major impact to the reputation requiring intervention from executive management, the Secretary of Transportation, or the Governor; requires prompt action by the Secretary of Transportation to implement new Departmental-level controls to treat the risk.
2. High (Orange)	The consequences that affect the ability of the Agency to carry out its mission and strategic plan - existing controls must be effective and require additional action to be managed at the executive management level.
3. Medium (Yellow)	The consequences impact completion of a critical Agency function - existing controls must be effective and possibly additional action implemented - action to be managed at Division level.
4. Low (Green)	The risk is managed within current practices and procedures - impacts are dealt with by routine operations at Director/Office level - monitor routine practices and procedures for effectiveness.

Controls for Strategic Risks

The controls for managed strategic risks were identified for three of the four DOTs used in the case studies. At the time of writing this report, Agency #4 was in the process of assessing strategic risks and therefore had not completed the process of establishing controls. Processes for establishing controls for strategic risks were identified at each of the four agencies and discussed below. A full list of strategic risk controls for Agency #1, #2, and #3 can be found Appendices F, G, and H, respectively. Examples of the controls developed at Agencies #1, #2, and #3 are included to demonstrate the products of each Agency's process of establishing controls.

Processes for Establishing Controls

Agency #1

Development of controls for strategic risks at Agency #1 was performed by the group of individuals that identified the agency's strategic risks and corresponding measures of those risks. The group included executives, senior management, and key staff from districts and programs. The managers from the Office of Enterprise Risk Management and Audits/Investigations facilitated the control development process. To develop controls, the group discussed the current controls in place, the established risk likelihood of occurrence, and potential consequence if the risk is realized. While discussing the controls currently in place, the group intended to identify all the means of controlling the risk or realizing an opportunity associated with the risk. The goal was to determine if the controls in place are sufficient and if not, what additional controls need to be established to manage the risk. The group discussed all means of controlling the risk and also if controls could be used to realize the risk as an opportunity. Ownership of the controls/monitoring was assigned to a specific individual.

Output of Process for Establishing Controls

Table 15 illustrates the actions in place and planned actions for a strategic risk category at Agency #1. The group that developed controls for strategic risks first discussed the likelihood, impact, and actions taken for the risk then developed planned actions to better control the risk.

Table 15. Output of Process to Establish Controls for Strategic Risks at Agency #1

Risk Category: Financial Risks from External Mandates		Action Taken or in Progress: <ul style="list-style-type: none"> • During the 2012 Strategic Planning cycle, the Agency explored legislative change proposals to net additional funding and ensure maximum integrity of existing funding. • As part of the 2012 Program Review process, the Agency began work with stakeholders to explore revenue options, review the CTIP voter threshold of local transportation tax measures, and to develop a fiscally constrained plan for addressing clear priorities with the decreasing level of funding projected for the future. • As part of the 2012 Program Review process, the Agency began development and implementation of strategies for new funding mechanisms beyond the gas tax. The Agency is participating with several other states in studies of road-based mileage fee programs. • The Agency has partnered with the Federal Highway Administration to develop easy-to-read guidelines on the Buy America provisions for utility companies.
Threat: If the zero-based budgeting process inadequately captures the Agency's workload, then resources may be cut without consideration for the unique nature and variety of work tasks; resources may be inadequate to perform the necessary work; products, services, and partnerships may suffer; reputational loss may occur; public safety may be jeopardized; and the highway system's health may be degraded.		
Likelihood	Impact	Planned Action: <ul style="list-style-type: none"> • Additional evaluation is planned for this risk to complete the risk analysis and identify treatment strategies. • The Agency will evaluate the effectiveness of the Performance Objectives and Measures as mitigating treatments for the risk category.
2	3	

Agency #2

Individuals that participated in strategic risk identification, as well as the assessment of each risk's potential impact, likelihood of occurrence, and level of management control established controls for strategic risks at Agency #2. In the assessment, the group calculated each risk's level by multiplying the impact score and likelihood of occurrence, and this value was plotted on a heat map against the level of management control for the risk. Using a heat map in this manner categorized the risks into four different levels. Table 16 describes the levels of risk used by Agency #2.

Table 16. Levels of Risk Used to Guide Development of Controls at Agency #2

Improve	Areas of inherently high risk exposure with a low level of control must be a key priority for improvements in management and control activities
Monitor	Areas of inherently high risk exposure where controls are deemed adequate should be monitored to provide ongoing assurance of control effectiveness
Accept	Areas of inherently low risk exposure that also have a lower level of control may be consciously accepted by the organization
Optimize	Areas of inherently low risk exposure with a high level of control may generate opportunities to optimize the management and control activities

To establish the controls, or control considerations in the case of Agency #2, the group considered the established level of risk for each strategic risk and then discussed each risk's level of management control currently in place. The levels of management for the risks fall within one of the following categories:

- **Highly Ineffective:** control nonexistent or major deficiency identified; control not operating as intended.
- **Ineffective:** limited control in place; high level of risk remaining.
- **Significant Improvement Needed:** key control in place with significant opportunities for improvement identified.
- **Limited Improvement Needed:** control properly designed and operating with opportunities for improvement identified.
- **Effective:** control properly designed and operating as intended.

Ownership of each risk was typically assigned to an individual or group that was determined to be best suited to manage the risk or the individual/group most affected by the potential effects of the risk. Appendix G presents a sampling of the control considerations that are used for each of the top 20 strategic risk categories of Agency #2. The actual list of control considerations is considerably longer so only the top three considerations for each category are displayed to provide an understanding of the output of the process and the results of the strategic risk controls at the Agency.

Output of Process for Establishing Controls

Considering the level of risk established in the assessment process (Table 16), the group discussed a series of questions for each strategic risk category to determine additional controls for

the risks. Table 17 provides an example of the control considerations for a specific strategic risk category used in the process of establishing additional controls.

Table 17. Sample Output of Process to Establish Controls for Strategic Risks at Agency #2

<p>Risk Category: Compensation and Benefits</p>	<p>Control Considerations: 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?</p>
<p>Established Level of Risk: Improve</p>	<p>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?</p>

Agency #3

The Senior Management Team at Agency #3 that participated in strategic risk identification workshops and developed risk measures also established controls for the identified risks. The team consisted of the District Engineer from each district in the Agency, the division head from each of the 24 Agency divisions, and is facilitated by the agency's Chief Financial Officer. Together, the team developed ten categories and examples of strategic risks facing the Agency and the likelihood of occurrence, impact, and readiness of the Agency to address the risks if they occur. The team then discussed what controls were currently in place to mitigate the risks. The discussions led to the development of a spreadsheet documenting the controls for the risks. The spreadsheet included information on the following elements:

- Risk category;
- Controls in place;
- Owner of the controls;
- Monitoring/reporting procedures;

- Control cycle; and
- Identified gaps in the management strategy for the risk.

Appendix H displays the controls and related elements for the strategic risks at Agency #3. The contact at Agency #3 stated that as strategic risks change over time, or new gaps in the controls are identified, the senior managers assign responsibilities to different staff members to develop mitigating controls. The target response for strategic risks at the Agency is mitigation and the Senior Management Team developed mitigation processes for each of the ten strategic risk categories.

Output of Process for Establishing Controls

The output of the control establishment process at Agency #3 is a detailed document containing the aforementioned elements for each risk. Table 18 provides an example of the output of establishing controls for a specific strategic risk category at the Agency. The Senior Management Team also identified gaps in the strategies to manage/mitigate the risk. Note that the processes in bold are the strategies determined by the management team as the strategies most critical to mitigating this risk.

Table 18. Sample Output of Process to Establish Controls for Strategic Risks at Agency #3

<u>Risk Category: Political</u>			
The Political risk category was identified by the Senior Management Team as the category with the 3 rd 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 State Highway and Transportation Commission form of government, loss of political support, and lack of a compelling vision for transportation.			
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
Identified Gaps:			
Ability to positively influence transportation funding at the national level			
Note: Bolded strategies have been identified by the management team as those most critical to mitigating this risk.			

Agency #4

The process for identifying and developing risk controls at Agency #4 occurred once strategic risks were identified and risk measures were established. Directors of divisions and teams of individuals from the division met in individual workshops to determine action strategies for each risk. The workshops were facilitated by representatives from the Agency's Department of Enterprise Risk and Safety Management. One of the contacts from Agency #4 indicated that the plans for the Agency's strategic risks are currently being established and therefore they are not available to be included in this report. However, established procedures are in place for creating strategic risk response plans and corresponding implementation plans were made available from the Agency representatives.

When response plans are created, the representatives from the Department of Enterprise Risk and Safety Management work with the individual divisions to identify the level of the risk (e.g. executive level or program level). Once the levels of the risks' consequences are identified, the group sets the framework for strategy development and develops a potential strategy for the risk. Different levels of oversight are used for each risk depending on the risk's severity level and therefore level of governance. For strategic risks at Agency #4, four possible risk responses exist: Transfer, Accept, Mitigate/Leverage, and Avoid.

Once the risk response has been determined, an action plan is developed to carry out the strategy for the risk. The action plan consists of two parts:

1. **Risk Response Plan** – the permanent plan to address the risk and consequences. Included in the response plan are:
 - a. Description of specific steps to take once the risk's trigger event occurs;
 - b. Assessment of what risk mitigation is currently available;
 - c. Roster that indicates Plan Manager, response plan lead supervisor, all other current positions involved in the response plan;
 - d. Roles and responsibilities for each of the members in roster;
 - e. Defined communication channels;
 - f. Equipment and supplies needed for the response plan and their respective locations;
and
 - g. Training or workshops needed.

2. **Implementation Plan** – staff, resources, and steps to implement the risk response plan:

- a. Plan manager;
- b. Response plan lead supervisor;
- c. Missing resources (based on response plan and assessment of needs and available resources);
- d. Acquisition schedule;
- e. Listing of individuals assigned to acquire missing resources;
- f. Necessary steps to get full readiness;
- g. Schedule for risk response plan including staff assignments;
- h. Development of training or workshops if determined they are needed; and
- i. Estimate of cost, time, and workforce needed.

The risk response plan is documented in a spreadsheet that also includes the risk number, status of the risk, risk title/name, impacted strategic goal and objective, risk category, risk description, risk trigger, and risk measures – likelihood score and value, severity score and value, and heat map displaying the level of risk.

Controls for Common Strategic Risks

The ERM programs investigated in this research in combination with previous published literature concerning the management of strategic risks provides eight common categories for strategic risk management in formal ERM programs. Controls for these strategic risks can be sorted by the risk categories to provide insights into how similar risks could be managed by any DOT with a formal ERM program. Table 19 provides a selection of the controls in place for the common strategic risks identified at the DOTs investigated in this research. As previously discussed,

Agency #3 documents strategic risks differently than the other agencies in this study (e.g., owner, reporting cycle, identified gaps), therefore only the controls in place for the risks are included in Table 19. See Appendix H for the full list of control elements documented by Agency #3. Each agency with documented controls had multiple controls in place for the risks but only a sample of the controls are included in Table 19.

Table 19 is intended to serve as a point of reference for common strategic risks to DOTs as others implement ERM programs and begin managing similar strategic risks.

Table 19. Controls in Place for Common Strategic Risks of Agencies with Formal ERM

Strategic Risk Category	Controls and Control Considerations for Common Strategic Risks
Human Resources/Work Force	<ul style="list-style-type: none"> • The Department developed performance measurements to ensure implementation of Knowledge Management techniques. The Department developed a comprehensive Knowledge Transfer Guidebook, associated website, and a training course for Agency staff. • The Agency has developed workforce plans for our primary occupational series. These plans include strategies on recruitment and retention. • Assistant district engineer/division leader and assistant to the district engineer positions are used as career paths to the Senior Management Team. Allows for continuous assessment of bench level strength and coaching/career development of those employees. • Accelerated Leadership Development Program emulates the Senior Management Team experience and with on campus and community recruitment programs feeds the pipeline to attract and develop employees that are representative of the communities we serve. • Is the HR department adequately staffed to efficiently and effectively execute their responsibilities? • Do you consider people to be qualified to perform their roles and responsibilities?
Information Technology	<ul style="list-style-type: none"> • As part of the 2012 Program Review process, the Agency created an IT Governance Committee to address IT issues within the Department, find innovative IT solutions, and streamline IT processes. • As part of the 2012 Program Review process, the Agency began to identify necessary technology changes along with an efficient IT procurement process. • Backup generators are in place at two data centers. The diesel-powered generators engage automatically during a loss of electrical power. • Firewalls, anti-virus software, spyware detection software and intrusion detection software are in place. • Does the IT department have a sufficient input in the Agency's strategic planning process? • Can IT in its current state (resources, infrastructure and systems) support or help enable the Agency's strategic objectives? Do systems facilitate work efficiency? Is timely, effective, reliable reporting available to facilitate decision-making?
Safety	<ul style="list-style-type: none"> • The Agency has an Incident Response Plan containing sub plans to address continuity of operations and specific risks such as severe weather, hazardous materials, radiological incidents, terrorism, a pandemic, an earthquake, and workplace security. • Organizational safety emphasis supported with training, incentives and discipline to drive safe behaviors in all activities. • Security infrastructure such as cameras, access control with key cards, photo IDs, panic buttons, door lockdown systems are in place. • Does the Agency coordinate with the Department of Homeland Security to plan for and monitor against malicious acts? • Has the Agency performed a risk assessment to identify areas of the infrastructure that are more likely to be subject to vulnerable attacks? • How does the Agency plan for terrorist activities and malicious acts to minimize the effect on the business and its customers?

Public Opinion/Communication	<ul style="list-style-type: none"> • External Affairs developed an Agency-specific marketing strategy to deliver a clear message about who we are and what we do. • External Affairs continues to conduct partnership workshops to improve communication, and timely, accurate and accessible traveler information and project updates. • Quarterly reporting exists and is actively used to manage Agency’s performance and publicly report information to maintain accountability and transparency. • Survey distributed to the public to assess customer satisfaction • Does the Agency suffer from a "negative" public perception? If so, why is this? Do you consider the Agency's Media Relations to be a driver as to why the Agency has a "negative" public perception? • Do you consider the type of information communicated to stakeholders as meeting their expectations?
Assets and Asset Management	<ul style="list-style-type: none"> • All bridges are inspected in accordance with an FHWA approved risk based set of criteria. Inspection frequencies are typically 24 months; however, they may go as high as 48 months for simple/newer bridges. Bridges in worse condition are inspected more frequently. Employees trained in bridge inspection are empowered to immediately close an unsafe bridge. • Use of the National Incident Management System model, developed by FEMA, to manage incidents. Training in and use of this scalable incident management framework allows a consistent response to incidents. • Dedicated interstate/major bridge funding within Commission funding distribution formula. • Are Agency assets operating to specification? Are employees encouraged to keep assets maintained? • To what extent are there assets in poor repair and thus presenting safety risks to employees and the general public as well as the potential for further damage to assets? • Are you aware of any failure to adhere to equipment maintenance schedules? Has poor maintenance resulted in any significant issues with equipment (e.g., fire, faulty structure or breakage)?
Contracting, Delivery, and Procurement	<ul style="list-style-type: none"> • The Division of Procurements and Contracts is streamlining the contract procurement process to minimize duplication with Department of General Services approval process. • The Division of Procurements and Contracts reviewed the procurement process, increased outreach and created a training and communications unit. • Innovative project delivery, including Practical Design; Design-Build; value engineering; alternative technical concepts; add alternates; and use of commodity indexes to mitigate contractor risks of price increases, thereby improving bids. • Is procurement integrated into the Agency's strategic plan? • Are buyers incentivized to achieve best possible costs for the Agency? • Is procurement decentralized, resulting in a sub-optimal process?
Financial	<ul style="list-style-type: none"> • The Agency explored legislative change proposals to net additional funding and ensure maximum integrity of existing funding. • As part of the 2012 Program Review process, the Agency began work with stakeholders to explore revenue options, review the CTIP voter threshold of local transportation tax measures, and to develop a fiscally constrained plan for addressing clear priorities with the decreasing level of funding projected for the future. • Prepare an annual financial forecast. • Do not fully program years 4 and 5 of the Statewide Transportation Improvement Program. • Does the Organization have difficulty obtaining access to adequate capital funding in the capital markets?

	<ul style="list-style-type: none"> • Do the operating practices of affiliated organizations, such as the RTAs, jeopardize the Agency's access to capital?
External/Third-Party/Legal	<ul style="list-style-type: none"> • The Agency began collaboration with FHWA to identify strategies to: streamline the Agency's oversight processes; identify potential highway routes for relinquishment to local partners; and work with federal and local partners to improve the local assistance program. • External Affairs continues to conduct partnership workshops to improve communication, and timely, accurate and accessible traveler information and project updates. • Existence of Governmental Relations Division with dedicated staff to monitor potential changes to laws that will adversely affect the Agency, educate on behalf of the Agency, and engage the Commission and Agency management as appropriate. • Strong relationships with stakeholders and industry partners that will lobby on the Agency's behalf. • How significant are Outsource Vendors/Alliances/Partners in the Agency's overall strategy? • Consider the nature and extent of these relationships: Do we rely on third parties to bill and collect significant revenues, to have systems that are reliable with minimal downtime, to have processes and controls to protect customer data, prevent fraud, to be compliant with applicable regulations, to exercise good judgment?

CONCLUSION

The research has indicated that implementation of formal ERM programs at DOTs is only in the formative stages but those with such programs are actively identifying and managing strategic risks. Therefore, it appears as if U.S. State DOTs are in transition with respect to ERM. The agencies investigated have adapted ERM programs from frameworks such as the COSO ERM Framework, ISO-31000, and programs at international agencies to fit the specific needs of their agency. Although the programs are all unique in their own right, certain trends and commonalities can be identified when looking at a holistic view of ERM at the agencies.

Strategic Goals and Strategic Risks

The strategic goals of an agency need to be clearly understood by all individuals in the agencies. This understanding will facilitate the process of identifying the risks to these goals and, ultimately, the entire risk management process. The strategic goals for an agency are specific to the strategic planning set forth by the agency's leadership. Commonalities were revealed in the DOTs analyzed that are believed to be consistent across all transportation agencies. Each of the agencies investigated claimed that Safety, particularly safety of employees and road users, is a strategic goal for the agency. Mobility, Customer Service, Asset Management/Preservation, Human Resources/Work Force risks and Financial Efficiency/Responsibility are also noted at a majority of the investigated agencies. Similarity in strategic goals was anticipated because DOTs perform similar functions and operations. Although similarity was found for many of the strategic risks, there were a few outliers. For example, Employee Engagement was stated as a strategic goal

by only one of the investigated agencies. Common strategic risk categories identified across the agencies analyzed included:

- **Human Resources** – Workforce development, Recruiting and Retention, Turnover
- **Information Technology** – Availability/Continuity, Failure/Destruction/Hacking
- **Safety** – Health/Safety of Employees/Road Users, Workplace Violence, Terrorist Acts
- **Public Opinion/Communication** – Credibility, Public Support, Public Relations
- **Assets and Asset Management** – System Performance, Major System Failure
- **Contracting, Delivery, and Procurement** – Core Service Delivery, Delivery Process
- **Financial** – External Mandate Risks, Funding Certainty, Annual Budgeting and Forecasting
- **External/Third-Party/Legal** - Foster Partnerships, Labor and Public Relations, Relationships

The investigated ERM programs all also had a risk champion in common. This champion spearheaded the ERM efforts and coordinated elements such as workshops and training sessions. Another important element identified across the investigated agencies is the involvement of senior level members in strategic risk identification workshops. These individuals typically have a strong understanding of the interrelationships between the different areas of the agency, which is believed to be valuable to recognizing how the risks may affect multiple divisions.

Measures for Strategic Risks

Assessing strategic risks at agencies with formal ERM programs involves considering not only the likelihood and impact of the risks as suggested by various risk management publications, Enterprise Risk Management in State Departments of Transportation

but also the level of management/control in place for the risks. This is believed to be significant in the establishment of additional controls to manage the risks. To establish the risk measures, the agencies use scales or rating systems that are developed internally. According to multiple contacts representing the agencies with formal ERM programs, the scales are developed internally to fit the needs of the agency and are more easily understood by the individuals participating in the assessments.

Strategic Risk Controls

Analyzing the controls for strategic risks at DOTs with formal ERM programs revealed the necessity to document specific elements to better manage such risks. The elements believed necessary to document include:

- Controls currently in place to manage the risk;
- Owner(s) to take responsibility of managing and monitoring the control process;
- Roles and responsibilities of individuals responsible for controlling;
- Risk measures from the assessment to understand the risks' likelihood and impact;
- Timeframes or deadlines to execute new controls;
- Reporting cycles;
- Any gaps or deficits in the controls that require attention;
- Resources required to control the risk; and
- Procedures or processes to enact if the risk is realized.

One agency investigated develops an *Implementation Plan* to identify the staff, resources and steps required to implement the response plan for each strategic risk. While this is a more advanced than what was observed at other agencies, it is believed to be an effective means of

understanding what is necessary to actually manage the risks that threaten an agency's mission and strategic goals.

LIMITATIONS OF RESEARCH

Although the information presented throughout this thesis can provide significant benefits to DOTs with formal ERM programs and those in the process of developing/implementing a formal ERM program, it is not without its limitations. The chief limitations are described below.

Relevance to ERM Programs

The strategic risks, measures, controls, and corresponding processes documented in the research are specific to DOTs with formal ERM programs. Management of these risks requires a holistic approach to risk management such as what is made possible by organization-wide ERM. The management plans for the strategic risks rely significantly on appropriate risk identification, assessment, and development of management plans that involve members from all of the divisions and departments of a transportation agency. Traditional risk management takes more of a *siloed* approach where risk management responsibilities are assigned to specific areas. The risk management techniques identified in this research relate to management of risks by teams that often consist of managerial-level individuals from various areas of the organization. The suggested approaches throughout the report imply the processes would be taken by an agency with an ERM program in place rather than an agency with a traditional, *silo* approach to risk management.

Active Risk Management Programs

The risk management techniques identified are components of ERM programs that are frequently updated and, as such, should be treated as dynamic elements of the agency. Many of the contacts interviewed throughout the research effort indicated the need to treat ERM as a process that is updated and improved constantly with scheduled identification and assessment workshops. The contacts stated that the strategic risks are frequently revisited to see what, if any, changes have occurred and how to adjust the risk management efforts. This research presents processes that are reliant on active ERM programs rather than identifying risks and management plans then shelving the documented items. Some elements and topics presented in the research can be used by risk management programs that are more static or traditional than the dynamic programs investigated (i.e. risk identification workshops, developing scales internally to assess risks, common strategic risks) but active ERM programs will maximize the suggested approaches to managing strategic risks.

Research Sample Size

As a result of the small number of U.S. State DOTs with formal ERM programs in place, the sample size of the research was very limited. While the results of the research still presented some similarities (i.e. categories of strategic risks managed, processes associated with ERM, risk champions), expanding the research to include international transportation agencies could significantly increase the validity of the findings. Increasing the sample size may also present the opportunity to identify additional similarities relating to ERM program maturity. The information collected is believed to be very valuable as new programs are developed but individuals

implementing ERM programs should consider that this research focuses on only 4 of 52 U.S. State DOTs.

Lack of Observed ERM Maturity

The agencies investigated had all recently implemented their ERM programs – three had been implemented within the past two years and the fourth was approximately five years ago. Time restraints prevented a longitudinal study of the ERM programs to understand how the programs are improved and change over time. The research into the ERM programs was focused on the current state of practice rather than that of an investigation into the improvements and changes made to the programs. As a result, the information presented focuses on development and implementation of ERM with less focus on advancing an ERM program from youthful to mature.

Mapping Strategic Risks to Strategic Goals

As was expected and then established in the investigation, DOTs will likely have similar strategic goals. The investigated agencies did not commonly link strategic risks back to the strategic goals/objective of the agency. Unfortunately, the ability to link strategic risks back to common goals was not established.

FUTURE RESEARCH

Additional research should be conducted on ERM within state DOTs. The following areas are potential future topics that could benefit the overall ERM body of knowledge.

Advanced Maturity Model

One of the goals of the NCHRP 8-36 (121) research is to develop a simple maturity model for members of DOTs to consider as they implement ERM programs within their agency. The benefits provided by a simple maturity model are expected to be substantial but additional research to develop an advanced maturity model could significantly aid the improvement of established ERM programs. An advanced maturity model will need to contain benchmarking data across DOTs. These benchmarking data are not yet available.

Management of Asset-related Risks

The FHWA has recently established mandates through the MAP-21 Act that will require a risk-based approach to asset management at state transportation agencies. The research revealed that agencies with formal ERM programs currently manage risks that threaten assets but that the assets managed at different agencies can vary significantly. For example, one of the investigated agencies possesses aeronautic assets and another manages assets associated with an extensive ferry system. Each class of assets is subject to unique risks and management of these risks will require proper identification, assessment, and controls. Agencies that have ERM appear more prepared for the requirements of the risk-based asset management approach but it is believed all DOTs will benefit from research into categories of asset risks.

Performance Measures for ERM Programs

Discussions with representatives of the agencies with formal ERM programs exposed a lack of performance measures to assess the successes and shortfalls of the programs. The representatives also discussed the tight budgets of public transportation agencies but that success of an ERM program requires resource allocation. It is believed that performance measures could

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provide agencies with a means of understanding what areas of the ERM program require additional attention and what areas are performing according to expectations.

Linking Strategic Goals to Strategic Risks

Research into strategic risks to common strategic goals is believed to have the potential to significantly improve the implementation of ERM at a transportation agency. Similarities were identified in the strategic goals of the investigated DOTs (Table 1) and research into the risks that typically affect these goals is believed to focus guide the initial efforts of DOT members as they establish which risks to manage in a new ERM program.

LOOKING BACK

If the opportunity to repeat this research effort was possible, I believe the final results could be improved by investigating DOTs that have documented and actively managed strategic risks and are also willing to provide information on the ERM programs. The original intent of the research effort was to conduct case study investigations on six agencies with formal ERM programs but the thesis only reports on four agencies. One of the six agencies was not included due to performing ERM at the project level, not at the enterprise level. The other agency investigated but not included in the final report did not have the level of information available for the case study. By investigating which DOTs are actively managing strategic risks through ERM programs and the actual risks that are being managed, the investigation could be more selective into which risks to study and document. However, the small number of DOTs with formal ERM programs in place could prevent the ability to be selective.

Another means of improving the final results would be to include some of the international agencies with formal ERM programs identified in the FHWA's International Risk Management scan tour (FHWA 2012). These agencies have ERM programs that are believed to be significantly more mature and advanced than those of the programs investigated in this research. Investigation into these agencies could provide data believed to be important to ERM programs such as performance measures, executive support strategies to improve the ERM program, and proven strategic risk management efforts. The research into these more established programs could also provide information that would better enable ERM programs at U.S. DOTs to reach a heightened level of maturity and therefore a more efficient ERM program.

PERSONAL TAKEAWAYS

Throughout this research effort, I have developed what I feel is a very thorough understanding of the components of an ERM program, and also an understanding of the means needed to develop and improve a risk management program. The exposure to the similarities and differences of the ERM programs investigated in the research has provided me with insight into the different processes currently being used to manage strategic risks. While the information relating to the specific risks, measures, and controls is extremely important and relevant to transportation agencies, for me, the notable takeaway is the understanding of what constitutes enterprise risk management at an organization. I feel confident in my ability to transfer the knowledge attained in this research into my professional career upon graduation. The bulk of this research was strictly related to ERM in the public transportation sector, but I believe that the ERM processes and components studied are transferable to any organization in any sector and of any

size. The prominent topics that I have learned that have aided my development as a professional entering the construction management industry include:

- Roles and responsibilities of members participating in enterprise risk management efforts;
- Categories and sources of strategic risks, both as threats and opportunities;
- Processes for identifying risks that threaten an organization's efforts to meet the mission and strategic goals;
- Means of assessing risks to establish measures of likelihood of occurrence, consequences if the risk occurs, and controls in place to manage the risks;
- Processes for establishing risk measures in both workshop settings and individual assessments;
- Methods of creating controls and management strategies for risks;
- Areas to consider when establishing control efforts; and
- Resources that are required for an effective enterprise risk management program

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APPENDIX A: CASE STUDY PROTOCOL MATRIX

Topic	Question	Responses	Data Collection Sources	Data Collection Methods
ERM Program Characteristics				
ERM Program Characteristics	What was the origin of ERM at the agency?			
ERM Program Characteristics	Who/what were the drivers of implementing formal ERM?			
ERM Program Characteristics	Who is the ERM champion at the agency?			
ERM Program Characteristics	What are the roles/responsibilities of this individual?			
ERM Program Characteristics	How has ERM been established as a part of your agency?			
ERM Program Characteristics	What performance measures exist to evaluate the ERM program?			
ERM Program Characteristics	What platforms are used to communicate ERM at the agency?			
ERM Program Characteristics	Is input from the public/external stakeholders retrieved and considered?			
ERM Program Characteristics	What changes, if any, have been implemented to improve/strengthen the ERM program with strategies for continuous improvement?			
ERM Program Characteristics	What results were achieved at the agency due to the implementation of ERM?			
ERM Program Characteristics	Any recommendations/best practice advice for other DOTs implementing ERM?			
ERM Program Characteristics	What supportive agency management strategies are in place to assist the ERM program?			
Strategic Risks				
Strategic Risks	What are the strategic risks for your agency?			
Strategic Risks	What are the categories and/or groups of strategic risks?			
Strategic Risks	What process was used to develop/identify these categories/groups?			

Strategic Risks	Why are risks categorized/grouped?			
Strategic Risks	Who participates in identifying strategic risks?			
Strategic Risks	What are the roles/responsibilities of these individuals for this task?			
Strategic Risks	What is the process/method for identifying strategic risks?			
Strategic Risks	What tools are used?			
Strategic Risks	When and how often does this occur?			
Measures				
Measures	What are the measures that correspond to the strategic risks at your agency?			
Measures	What are the levels of severity (consequence) used for measuring risks?			
Measures	How were these levels of severity developed?			
Measures	What are the levels of likelihood used for measuring risks?			
Measures	What risk levels (prioritization) are used when measuring risks?			
Measures	How are these levels considered?			
Measures	Who participates in establishing risk measures?			
Measures	What are the roles and responsibilities of these individuals for this task?			
Measures	What is the process/method for measuring risks?			
Measures	What tools are used?			
Measures	When and how often are risk measures created?			
Controls				
Controls	What are the controls that correspond to the strategic risks at your agency?			
Controls	What are the options for action strategies at your agency?			
Controls	Who participates in developing controls?			

Controls	What are the roles and responsibilities of these individuals for this task?			
Controls	What is the process for establishing controls?			
Controls	Are action plans created?			
Controls	Are risk controls assigned to an owner?			
Controls	What tools are used?			
Controls	When and how often are controls determined?			
Controls	What performance measures exist to evaluate the success of the controls?			

APPENDIX B: STRATEGIC RISK IDENTIFICATION TOOL

Strategic Risk Identification										
Risk Number	Risk Statement: "If _____ occurs, _____ is the result"		Risk Type: Threat or Opportunity	Risk Group	Risk Category	Impacted Strategic Goal	Impacted Area(s) (Program, division, department, etc.)	Risk Trigger (If known)		
Qualitative Assessment				Quantitative Assessment						
Likelihood of Occurrence	Impact	Controls currently in place		Likelihood Score	Impact Score	Level of Risk (Likelihood x Impact)				
Controls										
Risk Response	Action Taken	Action Planned	Identified Gaps in Ability to Manage Risk	Owner(s)	Roles and Responsibilities	Resources, Equipment, Training Needed	Reporting Cycle	Monitoring, Communication, Reporting Procedure	Performance Measures	Results of Management Effort

APPENDIX C: MEASURES FOR STRATEGIC RISKS AT AGENCY #1

Table 20. Threat and Opportunity Risk Measures at Agency #1

Develop Our Workforce	Likelihood	Impact
Threat #1: If the Agency does not actively engage in knowledge transfer, including providing good cross training opportunities, then institutional knowledge may be lost and employees may not have the confidence, knowledge or skill to perform their jobs.	3	2
Threat #2: If the Agency does not recruit and retain new employees, then the Agency may experience a generational vacuum with less experienced and knowledgeable employees, which may lead to a less effective workforce, low morale, and diminished work output.	3	3
Threat #3: If Agency management does not implement Workforce Planning solutions identified for specific occupational groups through the Workforce Planning process, then the Agency may not have employees in the right place at the right time; may not have leadership succession plans in place; may experience criticism from external agencies; and may be impeded in the best possible delivery of services to the State.	3	2
Develop Shelf Ready Projects and Project Initiation Documents	Likelihood	Impact
Threat #1: If our projects continue to only be developed for specific funds with no “shelf” of projects, then the Department may be unable to propose projects promptly and take advantage of new or unexpected funding sources.	3	3
Enhance Communication to Improve Reputation	Likelihood	Impact
Opportunity #1: If the Agency increased its social media presence and provided clear standards for use of accounts, then the public may perceive an increase in transparency, bolstering public confidence, improving relationships with stakeholders; improving Agency reputation; and enhancing employee pride and engagement.	3	3
Opportunity #2: If the Agency engaged the public through increased outreach, increased highway system information, and meetings with local partners, then we may increase acceptance of our projects, expand trust, and increase potential funding from local partners.	2	3
Opportunity #3: If the Agency promotes the great things it does through television, newspapers, public/legislative presentations and focused marketing and branding, then the Agency may provide a balanced perspective to the public and media, improving public perception and trust.	3	3
Engage and Support Employees	Likelihood	Impact
Threat #1: 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.	1	2
Opportunity #1: If all Agency employees feel that their contribution to the Department is valuable, then employee motivation may increase, employee morale may improve, employee retention may increase, and work products and services may improve.	3	2
Opportunity #2: If the Agency improved communication practices between management and staff, then the Agency may implement priorities more consistently, employee participation and engagement may improve, morale may increase, and engaged employees would produce a higher quality of work.	2	3
Opportunity #3: If the Agency revised its IDP form and process to be less cumbersome to complete, allow for focused evaluations for specific skills or classifications, and provide regular, meaningful, performance feedback to employees, then the Agency may see an increase in employee skill, work output and morale, and products and services may improve.	2	2

Ethical Employees and Strong Performance Management	Likelihood	Impact
Opportunity #1: If the timeframe and process for disciplining employees was accelerated, then discipline may be more effective, efficient and productive, boosting employee morale and saving state resources.	3	2
Opportunity #2: If the Agency could increase supervisor confidence and consistency in addressing employee misconduct, then morale for both supervisors and employees may improve; supervisors may be more inclined to address poor performance; services and products will improve as the quality of our workforce improves; and the Agency's reputation may improve.	3	2
Opportunity #3: If the Agency promulgates ethical behavior and conduct, including adequate performance of job duties, then employees may display behavior aligned with our values; employees may not accept inappropriate gifts from contractors; morale will increase as employees better understand our values and observe their coworkers behaving ethically; conflict of interest situations may decrease; Agency reputation with public, media, and political bodies may increase; and relationships with local partners may be enhanced.	3	3
Financial Risks from External Mandates	Likelihood	Impact
Threat #1: If the zero-based budgeting process inadequately captures the Agency's workload, then resources may be cut without consideration for the unique nature and variety of work tasks; resources may be inadequate to perform the necessary work; products, services, and partnerships may suffer; reputational loss may occur; public safety may be jeopardized; and the highway system's health may be degraded.	2	3
Threat #2: If the Buy America provisions of MAP-21 cannot be implemented by the Agency and our partners, then the Agency may be unable to certify projects and lose opportunities to maximize federal funds; relationships with local and federal stakeholders may suffer; and State communities may not receive beneficial projects.	2	3
Threat #3: If the Agency cannot fully expend federal funds because project costs are overestimated or project delays occur, then the Agency may not meet federal obligations; the Agency may miss additional funding opportunities; relationships with local and federal stakeholders may suffer; and State communities may not receive beneficial projects.	2	3
Opportunity #1: If the Agency received adequate funding, then the Agency may be able to deliver mandates and maintain our system with fewer delays; relationships with stakeholders may improve.	2	3
Flexibility in Environmental Stewardship	Likelihood	Impact
Threat #1: If the Agency does not responsibly streamline the environmental process, then the Agency may suffer project delivery delays, escalating project costs, increase inefficiencies, increase litigation, and diminished local partnerships.	2	3
Threat #2: If the Agency does not meet our environmental commitments, then we may receive notices of violations of environmental acts, suffer fines, increased project costs, degrade relationships with local, state and federal environmental partners and communities, and cause harm to the State's scenic and ecologically sensitive environment.	2	3
Foster Partnerships	Likelihood	Impact
Threat #1: If the Agency relinquishes projects or roadways to local partners and the partners do not follow our specifications for design, construction, or maintenance, then the Agency may incur increased costs due to reconstruction and maintenance needs.	2	3
Threat #2: If local partners devote increased attention to transit projects and the Agency maintains its primary focus on highways, then our role as a state leader in transportation may be diminished, we may be awarded fewer projects (as projects will be more transit based), and we may miss opportunities to receive new funding.	2	3
Threat #3: If public information regarding work zones is not sufficient or well coordinated with partners, then outreach may be reactive instead of proactive, and public/political leaders may respond negatively causing the Agency a loss of reputation and resources.	2	3

Threat #4: If information in the Advantage system is not accurate, then incorrect funds may be charged and could impact federal and local partners.	2	2
Opportunity #1: If the Agency maintained positive relationships with transportation partners (local agencies, CTC, etc.), then we may be viewed as the consultant of choice and maximize opportunities to receive funding to develop new projects, leading to reputational gain and improved public perception.	2	2
Increase Equipment and Vehicle Availability	Likelihood	Impact
Threat #1: If vehicle inventories remain at current post-reduction levels, there may be an increase in delays in responding to incidents, threatening public safety; the Agency may be ineffective and untimely responses to media and be unable to get information out to the traveling public; increases in leased vehicles may occur; and employees may be required to carpool to multiple locations, creating inefficiencies in staff time.	3	2
Threat #2: If data tracking for vehicle miles remains inadequate to prevent error or abuse, then employees may inaccurately log vehicle miles, which may result in vehicles being used unnecessarily reduced as low-mileage vehicles, decreasing the Agency's ability to respond to accidents, public safety, and inspections.	3	2
Threat #3: If the fleet, both light and heavy vehicles, continues to experience prolonged periods of time for service due to reducing staffing levels, then high levels of overtime may continue, which may degrade employee morale; availability of vehicles may decrease; we may lose vehicles due to low mileage reductions; employees may waste staff time by driving in teams to multiple locations; and there may be unacceptable delays in opening roadways.	3	3
Threat #4: If the Agency does not strengthen controls surrounding bulk fuel and the usage of Voyager cards, then fuel and cards may be used inappropriately, resulting in lost resources, diminished public perception, and reputational loss.	2	2
Opportunity #1: If the Agency embraced new roadway technology in surveys, traffic management, and other functions, then we could collect more accurate data; minimize employee presence on the roadways, reducing exposure to errant motorists, which may result in fewer injuries and fatalities; and allow employees to be utilized in other work areas.	2	3
Opportunity #2: If the Agency increased use of GPS tracking devices in vehicles, then abuse of vehicles by speeding, logging inaccurate fuel records, and engaging in inappropriate travel may be prevented; the Agency may better monitor project costs and employee behavior in vehicles, resulting in decreased waste, and more accurate responses to lawsuits and audits.	3	3
Innovative Information Technology	Likelihood	Impact
Threat #1: If the Agency is not up to date with current information technology trends and tools, then Agency productivity may be hindered and morale may erode; our ability to innovate and work efficiently may degrade; our current system may be harmed by age or unauthorized devices; and the Agency's presence as a national leader in transportation may be diminished.	2	2
Threat #2: If information technology service and support for the Agency is insufficient to the demand, then the Agency may be inefficient in our use of time and resources.	3	3
Opportunity #1: If the Agency had a data classification process, then appropriate levels of security may be assigned according to the confidentiality of the data, allowing for more efficient use of resources and greater ease in sharing data with partners and communities.	3	2
Opportunity #2: If the Agency embraced free web-based software (such as Skype and Youtube), then the Agency may be able to provide more efficient training, outreach, and other forms of communication to the public and our partners, increasing public confidence and highway efficiency and safety.	1	2
Opportunity #3: If the Agency utilized tablets for field work, then we may be more efficient in conducting inspections, improve morale, spend less time retyping handwritten field notes, and make better use of resources.	1	2

Reinvent Our Culture	Likelihood	Impact
Threat #1: If remote supervision and field crews remain geographically and culturally isolated, then isolated employee cultures may foment bullying and unethical behavior, which may lead to waste, abuse, workplace violence, retaliation, disgruntled employees and degraded morale; if the unethical violations are severe, criminal charges, media or legislative attention and reputation and fiscal loss may occur.	2	2
Threat #2: If the Agency allows political pressures and political interest groups to unreasonably influence decisions in delivery of work products and projects, then our reputation as an ethical agency may be compromised, the quality of our products and services may be diminished, we may be able to fund fewer projects, and employee morale and engagement may decline.	2	3
Opportunity #1: If the Agency refines regionalization to eliminate perceived conflicts and ensure each district receives adequate services, then projects may be programmed and delivered more efficiently, improving community relationships and strengthening internal partnerships.	3	2
Opportunity #2: If the Agency could improve the cultural divide between HQ and districts, then we may be more cohesive, improve morale and internal communication, strengthen internal/external stakeholder relationships, promote a clearer Agency identity, and ensure field employees have access to Departmental communications.	2	3
Strategic Cell Phone Deployment	Likelihood	Impact
Threat #1: If the Agency has insufficient cell phones available for critical areas, then there may be inadequate communication resulting in increased delays in incident response; slow and incomplete media responses; compromised worker and public safety; and delays in communicating system information to the traveling public.	2	3
Streamline the Project Delivery Process	Likelihood	Impact
Threat #1: If the expectation in contracts for delivery is 100%, then risk taking may be discouraged and the scope of projects reduced to meet delivery deadlines.	2	2
Threat #2: If the Agency focuses primarily on delivery, then the reality of construction (what it takes to build) may not be adequately explored; the Agency may experience increases in costs of delivery, delays, change orders, and construction stops, all of which affect and frustrate the public.	3	2
Opportunity #1: If the Agency increased outreach and communication to internal partners during the project development process, then the Agency may increase safety of designs, reduce worker exposure and minimize change orders during the project cycle.	3	3
Strengthen Contract and Procurement Processes	Likelihood	Impact
Threat #1: If contract/grant managers do not adequately monitor contract for performance and delivery of services and products, then contract deliverables may not be met and payments may be made for services not received, exposing the Agency to financial and reputational loss.	2	2
Threat #2: If the Cal-Card process is not revised to strengthen controls and oversight, then abuse, conflict of interest, and inappropriate charges may occur, exposing the Department to financial and reputational loss.	3	3
Opportunity #1: If the Agency used the purchase order process more regularly instead of Cal-Card, then the Agency's fiscal management and controls may be enhanced, ensuring that only appropriate purchases are made.	3	3
Opportunity #2: If the Agency provided comprehensive contract manager training, then contracts may be more appropriately managed, preventing loss of funds, payment for services not rendered, legal liability, and reputation loss.	2	3
Support Skilled and Ethical Supervisors	Likelihood	Impact
Threat #1: If the Agency does not enforce comprehensive policies, and document standards of operation, then waste and abuse may be inadequately controlled, resulting in lost resources, inadequate succession planning, reputation loss and increase in misconduct.	2	2

Threat #2: If communication of the Agency’s messages and application of policies is delivered inconsistently, then attempts to achieve strategic goals may be hindered.	3	3
Opportunity #1: If Agency supervisors are unilaterally held accountable for adequate oversight of employee performance, regular completion of IDPs, timely approval of timesheets, and other core supervisor responsibilities, then we may have improved employee morale; we would model our commitment to our shared values; our reputation may increase, and we may be more efficient in delivery of products and services.	2	2
Opportunity #2: If the Agency develops, implements and mandates comprehensive supervisor refresher training, then we may experience a culture shift in supervisory attitudes, increasing morale and supervisory effectiveness when motivating and disciplining employees, heightening ethical behaviors in both supervisors and employees, improving performance, and decreasing our liability from lawsuits.	2	3

APPENDIX D: HEAT MAP OF STRATEGIC RISKS MEASURES AT AGENCY #2

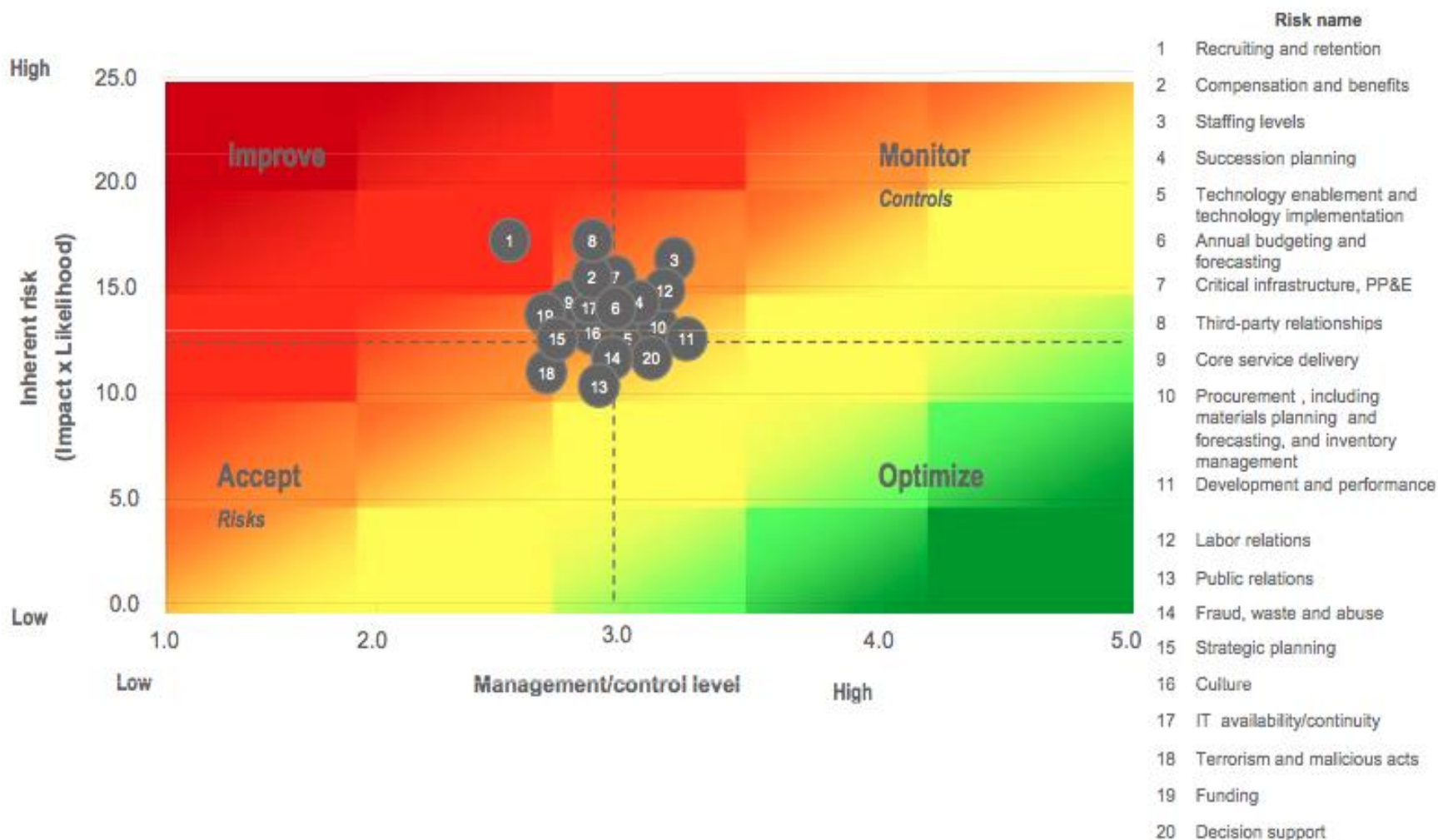


Figure 2. Heat Map Illustrating Risk Assessment Results at Agency #2

APPENDIX E: MEASURES FOR STRATEGIC RISKS AT AGENCY #3

Table 21. Readiness, Likelihood, and Impact Measures for Strategic Risks at Agency #3

Strategic Risk Category	Readiness	Likelihood	Impact
	Plans in Place<----->Unprepared 1 < ----- > 4	Little Chance<---->Fairly Certain 1 < ----- > 4	Little Impact<----->Devastating 1 < ----- > 4
Financial	2.3	3.2	3.6
Public Opinion/Support	2.3	2.6	3.3
Political	2.6	2.7	3.1
Work Force	2.2	2.6	2.9
Legal and Regulatory Changes	2.5	2.6	2.4
Major Transportation System Failure	1.6	2.0	2.7
Natural Disaster	1.4	3.0	2.6
Information Technology	2.1	2.1	2.7
Safety/Security	1.8	2.1	2.5
Fraud/Theft	1.7	2.4	1.7

APPENDIX F: TREATMENTS FOR STRATEGIC RISKS AT AGENCY #1

Table 22. Treatments for Strategic Risks at Agency #1

Strategic Risk Category	Treatments for Strategic Risk Category
Develop Our Workforce	<p>Action Taken or in Progress:</p> <ul style="list-style-type: none"> • During the Agency’s 2012 Strategic Planning cycle, the Department developed performance measurements to ensure implementation of Knowledge Management techniques. The Agency developed a comprehensive Knowledge Transfer Guidebook, associated website, and a training course for Agency staff. • The Office of Enterprise Risk Management (OERM) provides a Knowledge Transfer module in new supervisor training. • The Agency’s Deputy Director, Administration serves a panel member on the TRB’s nationwide research project, regarding Knowledge Transfer in transportation agencies. This will allow The Agency to incorporate national best practices in knowledge management into our workforce development. • The Agency has developed workforce plans for our primary occupational series. These plans include strategies on recruitment and retention. <p>Planned Action:</p> <ul style="list-style-type: none"> • Additional evaluation is planned for this risk to complete the risk analysis and identify treatment strategies. • In January 2014, the Agency will resume the Management Training Program. These programs will provide supervisors with the skills to develop staff using on-the-job techniques and leadership skills. • The OERM is developing Ethics training and a Code of Conduct for all employees to foster commitment to our mission, vision, goals and values and instill pride in the organization. • The Agency’s 2013-2018 Strategic Management Plan identifies Workforce Planning as a key objective. As part of this objective, The Agency set a goal of 90% implementation of 3-5 strategies identified for each primary occupational series’ workforce plan. • The Agency will evaluate the effectiveness of the Performance Objectives and Measures as mitigating treatments for the risk category.
Develop Shelf Ready Projects and Project Initiation Documents	<p>Action Taken or in Progress:</p> <ul style="list-style-type: none"> • The 2012 Program Review launched the development of a PID Strategic Plan focusing on three goals: (1) improving efficiencies throughout the PID Process; (2) improving management of the PID Program and PID resources; (3) providing transparent communication with internal and external PID stakeholders • The PID process has been streamlined to reduce cycle time by 30 to 50 percent and provide for a PID conflict resolution process <p>Planned Action:</p> <ul style="list-style-type: none"> • Additional evaluation is planned for this risk to complete the risk analysis and identify treatment strategies. • The Agency will evaluate the effectiveness of the Performance Objectives and Measures as mitigating treatments for the risk category

<p>Enhance Communication to Improve Reputation</p>	<p>Action Taken or in Progress:</p> <ul style="list-style-type: none"> • External Affairs has implemented QuickMap to assist the motoring public with travel information. • External Affairs continues to conduct partnership workshops to improve communication, and timely, accurate and accessible traveler information and project updates. • External Affairs developed an Agency-specific marketing strategy to deliver a clear message about who we are and what we do. • External Affairs is currently creating a Social Media Guide, which will enable Agency districts to use social media outreach more often and more quickly. <p>Planned Action:</p> <ul style="list-style-type: none"> • The Agency will produce an “Agency Report” for publication on our external website, highlighting completion of established performance measures. Legislative input will be included in the structure of the report.
<p>Engage and Support Employees</p>	<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 Agency’s 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.
<p>Ethical Employees and Strong Performance Management</p>	<p>Action Taken or in Progress:</p> <ul style="list-style-type: none"> • The OERM was created in February 2012. OERM is implementing department wide ethics training, a code of conduct, and ethics/whistleblower helpline. • The Agency is publishing an employee performance management newsletter that will provide tools and support to managers and supervisors. <p>Planned Action:</p> <ul style="list-style-type: none"> • The Agency plans to direct efforts to increase the percentage of Agency employees who are annually provided with performance appraisals. • Audits & Investigations will conduct an audit of the Agency’s disciplinary processes.
<p>Financial Risks from External Mandates</p>	<p>Action Taken or in Progress:</p> <ul style="list-style-type: none"> • During the Agency’s 2012 Strategic Planning cycle, the Agency explored legislative change proposals to net additional funding and ensure maximum integrity of existing funding. • As part of the 2012 Program Review process, the Agency began work with stakeholders to explore revenue options, review the CTIP voter threshold of local transportation tax measures, and to develop a fiscally constrained plan for addressing clear priorities with the decreasing level of funding projected for the future. • As part of the 2012 Program Review process, the Agency began development and implementation of strategies for new funding mechanisms beyond the gas tax. The Agency is participating with several other states in studies of road-based mileage fee programs. • The Agency has partnered with the Federal Highway Administration to develop easy-to- read guidelines on the Buy America provisions for utility companies. <p>Planned Action:</p> <ul style="list-style-type: none"> • Additional evaluation is planned for this risk to complete the risk analysis and identify treatment strategies. • The Agency will evaluate the effectiveness of the Performance Objectives and Measures as mitigating treatments for the risk category.

<p>Flexibility in Environmental Stewardship</p>	<p>Action Taken or in Progress:</p> <ul style="list-style-type: none"> • As part of the 2012 Program Review process, the Agency began efforts to streamline environmental approvals from state and federal resource/regulatory agencies and increase credibility with the State and Regional Water Quality Control Boards. • The Agency is exploring methods of streamlining environmental oversight with state environmental and resource agencies. • The Division of Environmental Analysis is pursuing an integrated information system with management and metrics tools that can efficiently process and deliver "product" information to stakeholders and decision makers while contributing to, and drawing upon, corporate knowledge. <p>Planned Action:</p> <ul style="list-style-type: none"> • Additional evaluation is planned for this risk to complete the risk analysis and identify treatment strategies. • The Agency will evaluate the effectiveness of the Performance Objectives and Measures as mitigating treatments for the risk category.
<p>Foster Partnerships</p>	<p>Action Taken or in Progress:</p> <ul style="list-style-type: none"> • As part of the 2012 Program Review process, the Agency began collaboration with FHWA to identify strategies to: streamline the Agency's oversight processes; identify potential highway routes for relinquishment to local partners; and work with federal and local partners to improve the local assistance program. • External Affairs continues to conduct partnership workshops to improve communication, and timely, accurate and accessible traveler information and project updates. • External Affairs developed an Agency-specific marketing strategy to deliver a clear message about who we are and what we do. <p>Planned Action:</p> <ul style="list-style-type: none"> • The Agency is pursuing activities to become the consultant of choice for local partners. • Additional evaluation is planned for this risk to complete the risk analysis and identify treatment strategies. • The Agency will evaluate the effectiveness of the Performance Objectives and Measures as mitigating treatments for the risk category.
<p>Increase Equipment and Vehicle Availability</p>	<p>Action Taken or in Progress:</p> <ul style="list-style-type: none"> • Agency Maintenance & Operations are working with internal programs and Districts to increase training to field staff on correct logging and tracking of mileage. • A management letter identifying voyager fuel card weaknesses was submitted to impacted program management. • A pilot program deploying GPS devices in vehicles is underway in several Agency districts. If successful, the program may be implemented statewide. <p>Planned Action:</p> <ul style="list-style-type: none"> • An audit of vehicle home storage permits is planned in 2014. • Additional evaluation is planned for this risk to complete the risk analysis and identify treatment strategies.

<p>Innovative Information Technology</p>	<p>Action Taken or in Progress:</p> <ul style="list-style-type: none"> • As part of the 2012 Program Review process, the Agency created an IT Governance Committee to address IT issues within the Department, find innovative IT solutions, and streamline IT processes. • As part of the 2012 Program Review process, the Agency began to identify necessary technology changes along with an efficient IT procurement process. • An audit of software management plans was issued in 2013. • External Affairs continues to conduct partnership workshops to improve communication, and timely, accurate and accessible traveler information and project updates. • The Agency will pursue many innovative products, tools and methods utilizing a continuous improvement model managed by a continuous improvement model managed by a two-year strategic planning cycle. The Agency will also focus on ways to expedite the process to test and implement new technologies. <p>Planned Action:</p> <ul style="list-style-type: none"> • Additional evaluation is planned for this risk to complete the risk analysis and identify treatment strategies. • The Agency will evaluate the effectiveness of the Performance Objectives and Measures as mitigating treatments for the risk category.
<p>Reinvent Our Culture</p>	<p>Action Taken or in Progress:</p> <ul style="list-style-type: none"> • The Agency is increasing communication to strengthen regional relationships and build positive lines of communication between HQ and Districts. • The Agency is sharing success stories to foster relationships and knowledge transfer between functional areas. • External Affairs continues to conduct partnership workshops to improve communication, and timely, accurate and accessible traveler information and project updates. • External Affairs developed an Agency-specific marketing strategy to deliver a clear message about who we are and what we do. <p>Planned Action:</p> <ul style="list-style-type: none"> • Additional evaluation is planned for this risk to complete the risk analysis and identify treatment strategies. • The Agency will evaluate the effectiveness of the Performance Objectives and Measures as mitigating treatments for the risk category.
<p>Strategic Cell Phone Deployment</p>	<p>Action Taken or in Progress:</p> <ul style="list-style-type: none"> • External Affairs continues to conduct partnership workshops to improve communication, and timely, accurate and accessible traveler information and Agency project updates. <p>Planned Action:</p> <ul style="list-style-type: none"> • The Agency will review cell phone distribution in the Agency and positions that require cell phones. The Agency will explore alternative methods of communicating from office to field staff. • The Agency will, as necessary, pursue approval for additional cell phones in the Agency. • Additional evaluation is planned for this risk to complete the risk analysis and identify treatment strategies. • The Agency will evaluate the effectiveness of the Performance Objectives and Measures as mitigating treatments for the risk category.
<p>Streamline the Project Delivery Process</p>	<p>Action Taken or in Progress:</p> <ul style="list-style-type: none"> • As part of the 2012 Program Review process, the Agency identified the need for, and began pursuit of, innovative project delivery processes. The Agency is continuing to explore and utilize project delivery methods such as Design Build and Construction Management/General Contractor. • External Affairs continues to conduct partnership workshops to improve communication, and timely, accurate and accessible traveler information and project updates. <p>Planned Action:</p> <ul style="list-style-type: none"> • Additional evaluation is planned for this risk to complete the risk analysis and identify treatment strategies. • The Agency will evaluate the effectiveness of the Performance Objectives and Measures as mitigating treatments for the risk category.

<p>Strengthen Contract and Procurement Processes</p>	<p>Action Taken or in Progress:</p> <ul style="list-style-type: none"> • As part of the 2012 Program Review process, the Division of Procurements and Contracts reviewed the procurement process, increased outreach and created a training and communications unit. • The Department of General Services has increased the Division of Procurements and Contract's approval authority. • The Division of Procurements and Contracts is streamlining the contract procurement process to minimize duplication with Department of General Services approval process. • Audits & Investigations is conducting a mandated audit of the Department of General Services' contract delegation to the Agency. • The Division of Procurements and Contracts created a new training branch, which will develop and implement statewide contract manager training. <p>Planned Action:</p> <ul style="list-style-type: none"> • Additional evaluation is planned for this risk to complete the risk analysis and identify treatment strategies. • The Agency will evaluate the effectiveness of the Performance Objectives and Measures as mitigating treatments for the risk category.
<p>Support Skilled and Ethical Supervisors</p>	<p>Action Taken or in Progress:</p> <ul style="list-style-type: none"> • 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. • Audits & Investigations provided statewide training on administrative investigation techniques. • The Agency is publishing an employee performance management newsletter that will provide tools and support to managers and supervisors. • External Affairs developed an Agency-specific marketing strategy to deliver a clear message about who we are and what we do. <p>Planned Action:</p> <ul style="list-style-type: none"> • The Agency plans to direct efforts to increase the percentage of Agency employees who are annually provided with performance appraisals. • The Agency is updating our CEA performance appraisal process to include new measurements for meeting performance objectives in support of the Agency's goals. • In January 2014, the Agency will resume the Management Training Program and Leadership Training Program. These programs will provide supervisors with hands- on experiences and tools to apply on the job. • Additional evaluation is planned for this risk to complete the risk analysis and identify treatment strategies. • The Agency will evaluate the effectiveness of the Performance Objectives and Measures as mitigating treatments for the risk category.

APPENDIX G: STRATEGIC RISK CONSIDERATIONS OF AGENCY #2

Table 23. Control Considerations for the Top 20 Strategic Risks at Agency #2

Risk Name	Control Considerations
Recruiting and Retention	1) Is the HR department adequately staffed to efficiently and effectively execute their responsibilities? 2) Do you consider people to be qualified to perform their roles and responsibilities? 3) How does the Organization ensure that your HR policies and procedures are adequate? Are there inconsistencies with hiring requirements for the same position in different areas of the business?
Compensation and Benefits	5) Does your 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? 6) Are employee titles appropriate to their business levels? 7) How does the Organization ensure that employees' compensation and benefits align to their expectations?
Staffing Levels	1) Is there a pervasive shortage of resources? 2) To what extent are vital functions and key activities with potential significant effect on stakeholders affected? 3) Is there a clear planned strategy to mitigate/manage the impact of resource shortages?
Succession Planning	1) Is there an effective succession planning process in place? Have key positions that need a successor to be identified and trained been agreed to? 2) What is the extent of key positions currently filled by retirement-eligible personnel for which there is no succession plan? How imminent and significant is this exposure? 3) Is HR currently process-capable to support the succession planning needs? Are resources appropriately prioritized to address any significant issues?
Technology Enablement and Technology Implementation	<p>Technology Enablement:</p> 1) Does the IT department have a sufficient input in the Organization's strategic planning process? 2) Can IT in its current state (resources, infrastructure and systems) support or help enable the Organization's strategic objectives? Do systems facilitate work efficiency? Is timely, effective, reliable reporting available to facilitate decision making? 3) Does IT have a strategic planning process that is aligned with the business in order for IT to be an enabler to the business and not just be a commodity service provider? <p>Technology Implementation:</p> 1) How does the Organization ensure major technology implementations are aligned to the business objectives? 2) Does the Organization have an established systems implementation methodology that includes a process to: <ul style="list-style-type: none"> • Formally document the business case and value of each system implementation and validating achievement of the business case? • Develop and communicate business requirements for major initiatives? • Ensure the business requirements are complete and satisfied at the end of the project? 3) Is there an established process to monitor the health of technology implementation projects?

Annual Budgeting and Forecasting	<ol style="list-style-type: none"> 1) Does leadership within operating units and departments receive regular updates on their budget to actual performance? 2) Are managers held accountable for their budget-to-actual performance? 3) Are the strategic planning and annual budgeting processes tied together (i.e., do you have the information you need to determine resources required to achieve the business objectives for which you are responsible)? Does your Organization have an annual budgeting process, which you consider to be efficient?
Critical Infrastructure, PP&E	<ul style="list-style-type: none"> • Are Organizational assets operating to specification? Are employees encouraged to keep assets maintained? • To what extent are there assets in poor repair and thus presenting safety risks to employees and the general public as well as the potential for further damage to assets? • Are you aware of any failure to adhere to equipment maintenance schedules? Has poor maintenance resulted in any significant issues with equipment (e.g., fire, faulty structure or breakage)?
Third-party Relationships	<ol style="list-style-type: none"> 1) How significant are Outsource Vendors/Alliances/Partners in the Organization's overall strategy? 2) Consider the nature and extent of these relationships: Do we rely on third parties to bill and collect significant revenues, to have systems that are reliable with minimal downtime, to have processes and controls to protect customer data, prevent fraud, to be compliant with applicable regulations, to exercise good judgment? 3) What is the Organization's risk exposure, if significant third parties (e.g., the RTAs and Transit Realty Associates (MBTA outsourced property manager)) are not compliant with contracts or are not appropriately diligent in conducting business on behalf of the Organization? Have the risks related to third parties been previously assessed to identify potential process and control gaps?
Core Service Delivery	<ol style="list-style-type: none"> 1) Does current capacity to deliver service meet demand? 2) To what extent is the quality of service being delivered meeting customer expectations? 3) Is service quality creating a risk of loss in ridership or damage to the Organization's reputation?
Procurement, including materials planning and forecasting, and inventory management	<p>Procurement:</p> <ol style="list-style-type: none"> 1) Is procurement integrated into the Organization's strategic plan? 2) Are buyers incentivized to achieve best possible costs for the Organization? 3) Is procurement decentralized, resulting in a sub-optimal process? <p>Materials Planning and Forecasting:</p> <ol style="list-style-type: none"> 1) How does your Organization manage master planning and forecasting? Does the Organization have any metrics/standards which it must adhere to? 2) How significant are the potential benefits (reduced cost, improved operational performance) from improving this process? <p>Inventory Management:</p> <ol style="list-style-type: none"> 1) Does your Organization have a sourcing strategy that supports its business objectives? 2) Does the Organization manage inventory to optimal levels? Are those levels defined? Are you aware of (recent) incidents of excess/insufficient inventory levels? 3) Is inventory management integrated with procurement? Is there an efficient and effective process to know what is in stock and the related quantity, and when to trigger a purchase?
Development and Performance	<ol style="list-style-type: none"> 1) Does your Organization realize the importance of developing its people? 2) Does the Organization have visibility into the training and developmental needs of personnel? 3) Are there significant unfulfilled training needs?
Labor Relations	<ol style="list-style-type: none"> 1) How do you monitor the current status of collective bargaining agreements? 2) How are effective relationships maintained with employee representatives? 3) How healthy is the relationship with the unions?

Public Relations	<ol style="list-style-type: none"> 1) Does the Organization suffer from a "negative" public perception? If so, why is this? Do you consider the Organization's Media Relations to be a driver as to why the Organization has a "negative" public perception? 2) How do you meet transparency expectations of regulators, the Board and other key stakeholders? 3) Do you consider the type of information communicated to stakeholders as meeting their expectations?
Fraud, Waste, and Abuse	<ol style="list-style-type: none"> 1) Has the Organization performed a Fraud Risk Assessment to identify areas that have relatively higher fraud risks? 2) Does the company have sufficient preventive or monitoring controls in areas where fraud is more likely (e.g., RMV) or where misrepresentations can have a severe impact on the public and its perception of the Organization (e.g., safety and inspection reports)? <ul style="list-style-type: none"> • How does your Organization prevent fraud in cash-heavy environments like the RMV and toll collection? • What policies are in place to prevent fraud in materials management? Are commodities tracked and inventoried? • What controls are in place to prevent the setup of unauthorized or fraudulent suppliers? • What approvals are required for purchases and payments? • Has the Organization had any (recent) incidents of fraud or theft? 3) What fraud prevention programs does the Organization have in place?
Strategic Planning	<ol style="list-style-type: none"> 1) What are the key inputs to the strategic planning process and how often are these updated? Does the strategic planning process appropriately include input from key stakeholders, such as IT and HR? 2) How are business priorities determined and how are business activities aligned to strategic objectives? 3) How are long-term objectives balanced against short-term goals and how are conflicts resolved?
Culture	<ol style="list-style-type: none"> 1) Do you believe your Organization fosters and instills in people a desire to be efficient and competent? 2) How well does the Organization create and instill a culture which is proactive and encourages behaviors that are consistent with the strategy (e.g., innovation, fiscal responsibility)? 3) How well does the Organization foster and instill in people a desire to speak up and communicate concerns and solutions and ultimately do the right thing (e.g., reporting fraud or abuse of company assets)?
IT Availability/Continuity	<ol style="list-style-type: none"> 1) Has the Organization experienced any (recent) incidents of system and network unavailability? 2) Are external vendors providing critical IT infrastructure? 3) Does the Organization have a process for managing problems with systems and networks?
Terrorism and Malicious Acts	<ol style="list-style-type: none"> 1) Does the Organization coordinate with the Department of Homeland Security to plan for and monitor against malicious acts? 2) Has the Organization performed a risk assessment to identify areas of the infrastructure that are more likely to be subject to vulnerable attacks? 3) How does the Organization plan for terrorist activities and malicious acts to minimize the effect on the business and its customers?
Funding	<ol style="list-style-type: none"> 1) Does the Organization have difficulty obtaining access to adequate capital funding in the capital markets? 2) Do the operating practices of affiliated organizations, such as the RTAs, jeopardize the Organization's access to capital? 3) Are operational and capital budgets kept separate? Are they used for their intended purposes (e.g. capital budget for capital expenditures)?
Decision Support	<ol style="list-style-type: none"> 1) Are systems currently capable of providing management with the relevant information needed to make effective business decisions? 2) Do you consider data extracted from the system to be accurate and reliable? 3) Is the Organization heavily reliant on manual input and the loading of data from external sources, e.g., Excel spreadsheets?

APPENDIX H: CONTROLS FOR STRATEGIC RISKS AT AGENCY #3

Table 24. Controls for Strategic Risks at Agency #3

Risk Category	Controls	Control Owner	Monitoring and Reporting	Control Cycle	Identified Gaps
Financial	Prepare an annual financial forecast	Financial Services	Approved by Executive Team and provided to Commission	Annual	<ul style="list-style-type: none"> • Growing appropriations to state police • Rapidly increasing cost of retirement and health care
	Innovative project delivery, including Practical Design; Design-Build; value engineering; alternative technical concepts; add alternates; and use of commodity indexes to mitigate contractor risks of price increases, thereby improving bids	Chief Engineer, Design and Districts	Monitoring through bid process and Staff Bid Review	Monthly	
	Do not fully program years 4 and 5 of the statewide transportation improvement program	Trans. Planning and Districts	Reviewed by Executive Team and approved by Commission	Annual	
Public Opinion/ Support	Use of Funding Distribution formula to distribute funds to regions	Commission and Trans. Planning	Statewide Transportation Improvement Program	Annual	None noted
	Customer Satisfaction Survey	Customer Relations	Report provided to Commission and Senior Management Team and shared with customers through multiple communication tools	Annual	
	Quarterly report exists and is actively used to manage Agency's performance and publicly report information to maintain accountability and transparency	Customer Relations	TRACKER	Quarterly	
Political	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	Gov't Relations	Report to Commission and Legislative Committee meetings	Ongoing	<ul style="list-style-type: none"> • Ability to positively influence transportation funding at the national level.
	Use of the Commission funding formula and planning process to de-politicize decision-making	Trans. Planning	Statewide transportation improvement program	Annual	
	Strong relationships with stakeholders and industry partners that will lobby on the Agency's behalf	Exec. Mgmt.	Informal	Ongoing	

Work Force	Assistant district engineer/division leader and assistant to the district engineer positions are used as career paths to the SMT. Allows for continuous assessment of bench level strength and coaching/career development of those employees	Entire Senior Mgmt. Team	Informal	Continuous	<ul style="list-style-type: none"> •Lack of systematic method to raise salaries •No incentive for SMT members to remain after earning their maximum backdrop
	Robust employee benefits including pension plans and health care, as well as training and support programs that assist with an appropriate work/life balance	Commission, Exec. Mgmt., Human Resources	Employee survey – currently suspended but expected to resume in 2013	Annual	
	Accelerated Leadership Development Program emulates the Senior Management Team experience and with on campus and community recruitment programs feeds the pipeline to attract and develop employees that are representative of the communities we serve	Human Resources and Equal Opportunity and Diversity	Annual report and quarterly TRACKER measures	Annual and quarterly	
	Strong liaison relationship between Central Office and District Human Resources staff, and Chief Counsel’s Office, to ensure consistent approach and advice on workforce issues	Human Resources and Chief Counsel’s Office	Ongoing	Continuous	
Legal and Regulatory Changes	Existence of Governmental Relations Division with dedicated staff to monitor potential changes to laws that will adversely affect the Agency, educate on behalf of the Agency, and engage the Commission and Agency management as appropriate	Gov’t Relations	Report to Commission and Legislative Committee meetings	Ongoing	<ul style="list-style-type: none"> •Little to no ability to positively influence legislation at the federal level
	Strong relationships with stakeholders and industry partners that will lobby on the Agency’s behalf	Exec. Mgmt.	Informal	Ongoing	
Major Transportation System Failure	All bridges are inspected in accordance with an FHWA approved risk based set of criteria. Inspection frequencies are typically 24 months; however, they may go as high as 48 months for simple/newer bridges. Bridges in worse condition are inspected more frequently. Employees trained in bridge inspection are empowered to immediately close an unsafe bridge.	Bridge	Monthly status checks with report to FHWA each April 1	Annual	<ul style="list-style-type: none"> • Insufficient resources to rebuild I-70 and then I-44
	Emergency contracting authority allows for fast contractor mobilization	Design	Approved by Chief Engineer and reported to Commission at the next Commission meeting following award	As needed	

	Use of the National Incident Management System (NIMS) model, developed by FEMA, to manage incidents. Training in and use of this scalable incident management framework allows a consistent response to incidents	Traffic and Highway Safety	Drills conducted periodically, alone or in cooperation with other agencies	As needed	
	Dedicated interstate/major bridge funding within Commission funding distribution formula	Trans. Planning and Districts	Statewide transportation improvement program approved by Executive Management and Commission	Annual	
Natural Disaster	The Agency has an Incident Response Plan containing subplans to address continuity of operations and specific risks such as severe weather, a pandemic, radiological response, and an earthquake	Traffic and Highway Safety	Update by Incident Response Plan Team	Annual	None noted
	Use of NIMS model, developed by FEMA, to manage incidents. Training in and use of this scalable incident management framework allows a consistent response to incidents	Traffic and Highway Safety	Drills conducted periodically, alone or in cooperation with other agencies, including disaster drills	As needed	
	For snow events, Emergency Operations Centers at Central Office and in each district are activated based on need. Statewide conference calls (multiple per day) are used to communicate weather predictions, evaluate resource needs and availability of those resources, and when necessary, mobilize crews and equipment to other parts of the state	Maintenance	As needed	As needed	
Information Technology	Backup generators are in place at two data centers. The diesel powered generators engage automatically during a loss of electrical power	Info Systems and General Services	Weekly testing and annual services	Weekly and Annually	
	Firewalls, anti-virus software, spyware detection software and intrusion detection software is in place	Info Systems	Firewall, Intrusion detection: Alerts generated and sent to technologists in the event of thresholds being exceeded. Antivirus/Spyware: Alerts of viruses/spyware sent to technologists, escalation if multiple events	Ongoing	

	Cable is located in a redundant ring configuration to reroute internet traffic in the event of a fiber optic cable disruption	Info Systems	Ongoing. Reported on in the event of a break or cut	As needed	
	The data centers are geographically distant to make it unlikely that a single natural disaster would significantly impact both at the same time	Info Systems and General Services	N/A	N/A	
Safety and Security	The Agency has an Incident Response Plan containing sub plans to address continuity of operations and specific risks such as severe weather, hazardous materials, radiological incidents, terrorism, a pandemic, an earthquake, and workplace security	Traffic and Highway Safety	Update by Incident Response Plan Team	Annual	None noted
	Security infrastructure such as cameras, access control with key cards, photo IDs, panic buttons, door lockdown systems	Risk and Benefits Mgmt.	N/A	N/A	
	Organizational safety emphasis supported with training, incentives and discipline to drive safe behaviors in all activities	Risk and Benefits Mgmt.	TRACKER	Quarterly	
Fraud and Theft	Existence of the Audits and Investigations Division to conduct audits, including internal control audits, of the Agency and sub recipients, to assess whether controls are sufficient to provide reasonable assurance of the prevention and detection of fraud	Audits and Investigations	Reports are presented to the Commission Audit Committee	Three to four times per year	None noted
	The Agency has an independent CPA perform an annual audit of the financial statements. The audit includes a report on internal controls over financial reporting	Financial Services	Report is presented to the Commission Audit Committee and to the Commission as a whole	Annual	
	The Agency has a comprehensive system of internal controls to prevent and detect fraud, waste, abuse, and misuse of resources	Financial Services	Ongoing	Ongoing	