Effective Organizational Models for Transportation Asset Management

Findings from NCHRP Project 08-36 Task 144 and NCHRP Project 08-113

presented to

Transportation Asset and Infrastructure Management (TAIM) Conference 2019

presented by

Brian ten Siethoff, Principal

CAMBRIDGE SYSTEMATICS

Think *Forward*

October 29, 2019

Presentation Overview

- NCHRP Project 08-36, Task 144
  Transportation Asset Management and Effective Organizational Models for Program Implementation
  - Research Objectives
  - Survey Findings
  - Organizational Models
- NCHRP Project 08-113
  Integrating Effective Transportation Performance, Risk, and Asset Management Practices
  - Research Objectives
  - Findings to Date
  - Future Direction

NCHRP Project 08-36 Task 144 Objectives

1. Identify and characterize the factors comprising the best organizational structure(s) for Asset Management where multiple criteria are used for decision making

2. Develop a framework to connect asset and performance management
   - » Guidance for resource allocation that supports agency goals and public needs
   - » Organizational Models

- RESULT = Better understanding of how TAM can relate to transportation goals that are broader than sustaining and/or improving asset condition

Background and Motivation

- Transportation Asset Management (TAM) has emerged as an effective method of allocating resources
  - Balancing current asset condition, desired performance, and limited funding
  - Meeting Federal Transportation Performance Management requirements
- There is a need to:
  - Understand the connection between TAM and other transportation goals and objectives (e.g., safety, access to opportunity, triple-bottom-line outcomes)
  - Achieve balance in addressing asset management, agency goals through more effective long-range transportation planning and programming

Review of Candidate TAM Frameworks

- Developed template for data collection, including self assessment tool
- Identified candidate agencies
- Conducted 15 interviews and compiled results of self assessments
- Summarized business processes
- Conducted follow-up phone calls
- Identified relationships between TAM and broader goals/objectives
- Extracted organizational information

Process and Technology Capabilities

		Q2 Asset Inventory and Performance Measures	Q3 Management Systems and Strategy Identification	Q4 System Integration and Information Management	Q5 TAMP and Other Planning	Q6 Tradeoff Analysis, Resource Allocation & Target Setting	Q7 Project Formulation, Evaluation & Selection	Q8 Risk Management	Q9 Performance Management	TOTAL[b]
State DOTs	Colorado	4	3	5	4	5	2	4	3	30
	Idaho	4	2	2	1	1	2	2	1	15
	Michigan	2	3	3	1	4	2	2	3	20
	Nevada	4	4	1	2	2	2	2	3	20
	New Mexico	2	1	2	1	2	1	1	1	11
	New York	3	4	4	4	3	2	2	1	23
	North Dakota	3	2	3	4	2	2	2	2	20
	Ohio	3	3	3	4	3	2	3	2	23
	Oregon	4	3	3	1	3	4	3	4	25
	South Carolina	4	3	3	2	3	2	4	3	24
	Utah	2	2	2	4	2	3	2	3	20
	Virginia	4	4	3	2	4	4	3	4	28
AVERAGE OF **ALL** STATE DOTs SURVEYED		3.3	2.8	2.8	2.5	2.8	2.3	2.5	2.5	21.6
AVERAGE OF "**TOP HALF**" OF STATE DOTs SURVEYED[c]		3.7	3.3	3.5	2.8	3.5	2.7	3.2	2.8	25.5
AVERAGE OF "**BOTTOM HALF**" OF STATE DOTs SURVEYED[d]		2.8	2.3	2.2	2.2	2.2	2.0	1.8	2.2	17.7
International Agencies	Australia	3	4	3	2	2	4	5	3	26
	Sweden	3	3	3	3	3	3	5	3	26
	South Africa	4	4	5	4	4	3	5	3	32
	Scotland	2	3	2	5	2	2	5	2	23
	England	2	2	3	2	2	3	4	2	20
AVERAGE OF INTERNATIONAL AGENCIES		2.8	3.2	3.2	3.2	2.6	3.0	4.8	2.6	25.4
GLOBAL AVERAGE *(OF ALL DOMESTIC AND INTERNATIONAL AGENCIES SURVEYED)*		3.1	2.9	2.9	2.7	2.8	2.5	3.2	2.5	22.7

Organizational Factors

		Q10 TAM Roles, Responsibilities & Expectations	Q11 TAM-Related Training	Q12 TAM Leadership & Vision	Q13 Incentives per the TAM Vision	Q14 TAM Organizational Structure	Q15 Internal Interactions & Communications Re: TAM	Q16 Succession Planning & Knowledge Retention	Q17 Trust and Willingness to Engage in Open Dialogue	Q18 Data Management and Governance	Q19 Partner and Stakeholder Collaboration and Comm.	TOTAL[b]
State DOTs	Colorado	3	1	4	1	4	4	1	4	2	2	26
	Idaho	4	1	2	3	4	1	2	3	4	3	27
	Michigan	3	2	2	3	3	3	2	4	2	2	26
	Nevada	3	3	3	1	3	3	2	4	3	2	27
	New Mexico	3	1	3	1	2	2	1	1	2	1	17
	New York	4	2	4	3	3	2	1	4	4	1	28
	North Dakota	3	2	2	3	3	5	2	3	2	3	28
	Ohio	3	2	4	4	3	3	2	1	4	4	30
	Oregon	3	3	3	3	4	4	2	4	3	4	33
	South Carolina	3	2	3	3	2	2	2	5	2	2	26
	Utah	3	2	3	2	4	3	2	4	3	2	28
	Virginia	5	5	4	4	5	5	4	5	3	4	44
AVERAGE OF **ALL** STATE DOTs SURVEYED		3.3	2.2	3.1	2.6	3.3	3.1	1.9	3.5	2.8	2.5	28.3
AVERAGE OF "**TOP HALF**" OF STATE DOTs SURVEYED[c]		3.5	2.7	3.3	3.2	3.7	3.7	2.2	3.5	3.2	3.0	31.8
AVERAGE OF "**BOTTOM HALF**" OF STATE DOTs SURVEYED[d]		3.2	1.7	2.8	2.0	3.0	2.5	1.7	3.5	2.5	2.0	24.8
Int'l Agencies	Australia	4	2	4	4	3	3	2	4	4	3	33
	England	3	2	3	2	3	3	2	3	3	2	26
	Scotland	2	2	3	2	3	2	1	4	2	2	23
	South Africa	3	4	3	4	2	3	2	4	5	2	32
	Sweden	3	3	4	3	3	3	3	4	4	4	34
AVERAGE OF INTERNATIONAL AGENCIES		3.0	2.6	3.4	3.0	2.8	2.8	2.0	3.8	3.6	2.6	29.6
GLOBAL AVERAGE *(OF ALL DOMESTIC AND INTERNATIONAL AGENCIES SURVEYED)*		3.2	2.3	3.2	2.7	3.2	3.0	1.9	3.6	3.1	2.5	28.7

CAMBRIDGE SYSTEMATICS

Shortcomings of All Agencies

- Risk Management and integration of risk with asset management and performance management
- Succession planning and knowledge retention
- Target setting and evaluation of investment decisions relative to targets
- Training and availability of the right staff for the right job

Success Factors for Highest-Maturity Agencies

Decision Making Frameworks

Multiple Criteria Project Selection (or MODA).

- Consider a range of factors, beyond just asset condition, when prioritizing projects and developing capital programs.
- Some agencies establish funding geographically to districts or regions first before implementing multiple criteria project selection within those geographic bounds

"High-level Investment Buckets"

- Dedicate resources at a high level to "investment buckets" corresponding to a range of objectives beyond improving or maintaining asset condition
- Use combination of leading indicators (e.g., spending in capital program) and lagging indicators (actual results/outcomes) to help inform decisions

Strategic Project Formulation and Delivery

- Formulate projects at a strategic level, and then deliver specific projects aimed at achieving intended strategic goals beyond condition
- Track whether the dedicated amount of funds were spent as intended
- Compare project outcomes with the originally anticipated results.

Example: Multi-Criteria Decision Making

People	Processes	Technologies and Data Sources
Headquarters/Central Office Staff	Run asset management systems in order to set preliminary funding allocations to the districts/regions based on benefit/cost ratios for proposed condition improvement projects.	Asset Management Systems; Proposed condition improvement projects; project-specific benefit/cost ratios or qualitative benefit/cost score by treatment type.
Headquarters/Central Office Staff	Make performance projections, recommend final funding allocations (to regions/districts), and recommend targets for condition-based measures (e.g., pavement and bridge conditions).	Asset Management Systems; Resource allocation and tradeoff tools; Asset deterioration models; Financial assumptions.
Senior Management, in coordination with Region/District Office Management and MPOs	Review performance data, recommended funding allocations, and recommended targets, and determine final funding allocations at the region/district level.	Asset Management Systems; Financial assumptions; Resource allocation and tradeoff tools.
Headquarters/Central Office Staff or Region/District Office Staff	Re-run asset management systems with final funding allocation amounts to generate recommended mix of strategies/treatments to address condition-related deficiencies.	Asset Management Systems; Financial assumptions.
Headquarters/Central Office Staff or Region/District Office Staff	Formulate project candidates and evaluate candidates (individual projects or bundles projects) based on both condition-based and non-condition-based criteria.	Asset Management Systems; Operational Performance Management Systems; Safety Management Systems; Travel demand models; other performance management systems and forecasting tools.
Headquarters/Central Office Staff or Region/District Office Staff	Select projects for Capital Program based on multiple criteria.	Capital Program Development Tools.
Headquarters/Central Office Staff	After appropriate time horizons, measure outcomes (Lagging Indicators), and compare these with the original results projected from management systems and other tools (Plan versus Actual analysis). Over time, use this information to manage performance and minimize the risks associated with not hitting performance targets for condition-based measures. Quantify and publish non-condition potential benefits alongside condition-based measures/projections.	Performance Management Information Systems, Dashboards, and Reports.

INTEGRATING EFFECTIVE TRANSPORTATION PERFORMANCE, RISK, AND ASSET MANAGEMENT PRACTICES

FINDINGS FROM NCHRP PROJECT 08-113

CAMBRIDGE SYSTEMATICS

NCHRP Project 08-113 Research Objectives

- Provide transportation agencies with practical guidance, recommendations, and implementation practices for:
  - Integrating performance, risk, and asset management into transportation agencies
  - Identifying, evaluating, and selecting appropriate management frameworks
  - Recruiting, training, and retaining human capital to support these integrated management functions

Domestic DOTs Have Integrated 2 of 3 Management Practices, But None Has Integrated All 3

Risk-Based Transportation Asset Management Plans (TAMPs)	Links between Asset Performance and Safety in Transit Asset Management Plans (TAM Plans)	Spread of Enterprise Risk Management
Risk-Based Project Selection for Resilience Projects	Schedule and Budget Risks in Project Delivery	Sensitivity Testing for Benefit Cost Analysis and Travel Demand Model Outputs

Agencies Are Making Progress, But Face Headwinds

• Federal Asset Management regulations require risk-based asset management within a broader performance management framework	• Some agencies are just focused on meeting the Federal requirements due to resource constraints, with no focus on integration
• Many agencies have begun to understand risk by developing a risk register and acting on it	• A holistic approach to risk management includes more than just risks directly related to assets (e.g., equity, environmental, economic)
• More advanced information systems are helping decision makers better understand current and projected conditions	• Limitations of data availability and information systems' capabilities continue to hinder integration
• Training is improving, becoming more customized to staff capabilities	• Loss of institutional knowledge and experience is a continuous threat

CAMBRIDGE SYSTEMATICS

NHDOT Has Investigated its Risks and Approaches to Manage/Reduce Them

RISK:
Pavement damaged by overweight vehicles

ASSET MANAGEMENT SOLUTION:
High-strength pavement used in acceleration/deceleration lanes with high freight traffic

Caltrans Has Begun to Assess Projects Based on Projected Impacts on Performance Goals

- Crash reduction benefits from pavement management treatments:

04-Alameda-Var 1481B 0414000357	In Alameda County, on Routes 80, 84, and 880 at various locations; also in Contra Costa County on Routes 24 and 680 at various locations. Install High Friction Surface Treatment (HFST) at spot locations to enhance wet pavement conditions.	1J780 2020-21	R/W: Const:	$10 $6,311	PA&ED: PS&E: R/W Sup: Con Sup:	$1,118 $1,274 $104 $1,534	18-19 19-20 19-20 21-22	PA&ED: R/W Cert: RTL: Begin Con:	10/1/2019 3/1/2021 6/1/2021 2/1/2022
			Subtotal:	$6,321		$4,030			
			Total Project Cost:			**$10,351**			

New

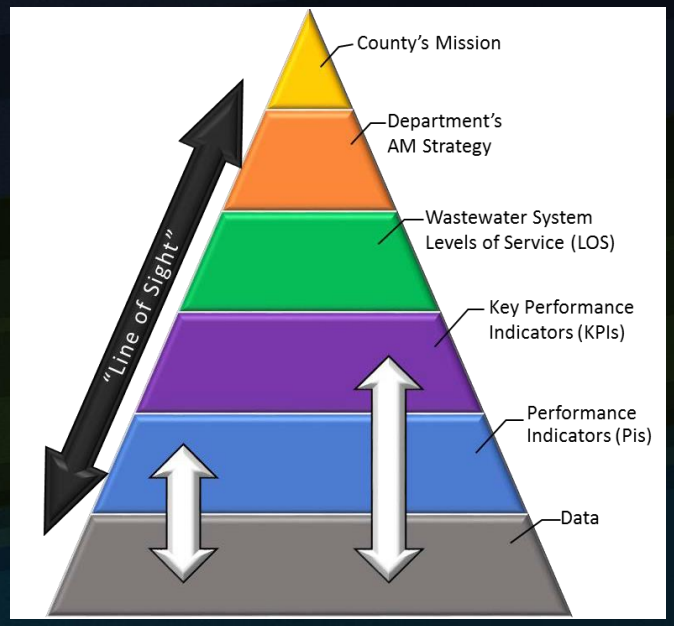
Program Code 201.015 Collision Severity Reduction
Performance Measure 24 Collision(s) reduced

CAMBRIDGE SYSTEMATICS

Some States Are Pursuing Integration of All Three Management Areas

Agency requirements for successful integration:

- Staff training, organization, and culture (**people**)
- Procedures and documentation (**processes**)
- Data and tools supporting integration (**technologies**)



Source: New Caste County, Delaware "line of sight" from Performance to Asset Management and ultimately agency strategy and mission

CAMBRIDGE SYSTEMATICS

Quick Scan Case Studies Provided Broad Look at 13 Diverse Agencies

- Cross-section of a 13 diverse agencies
  - » Transportation & other sectors
  - » US and international
  - » Local, regional, and state-level
- Summarized in 13 one-pagers and a noteworthy practices document
  - » Easy to read, draw insights
  - » Results helped identify Deep Dive candidates

NCHRP 08-113: QUICK SCAN SUMMARY

Agency/Organization:	Main Roads Western Australia	AMP Date:	2018
Location:	West Australia, Australia	PMP Date:	NA
Sector:	Transportation	RMP Date:	NA
Contact Name:	Brett Belstead		
Contact Title/Dept.:	Director of South West Operations		

mainroads WESTERN AUSTRALIA

OVERVIEW

Main Roads West Australia (MRWA) is the transportation agency of the state of Western Australia which is responsible for managing, maintaining, and improving more than 18,500 kilometers of roads, as well as implementing state policies regarding network operations and compliance. The public highways and main roads under MRWA's purview make up much of the Australian state's arterial roadway network, providing statewide connectivity. These roads complement the networks managed and maintained by local agencies throughout the state and are an essential element of Western Australia's economy.

LEVEL OF INTEGRATION
☐ High
☒ Moderate
☐ Low
☐ None

INTEGRATED PRACTICES
☒ Asset Management
☒ Performance Mgmt.
☒ Risk Management

APPROACHES TO INTEGRATION

MRWA has identified the integration of asset, performance, and risk management as an important objective of their agency. Though integration is still developing, they currently employ a number of practices to implement a more modern, holistic approach to managing their network. For MRWA, this is largely top-down, with a corporate risk process which reaches through each branch of the agency, across regional and divisional divides. Additionally, they have a performance management system which looks at cost-benefit of capital projects, driver exposure and safety, high-level congestion management, and more, requiring these measures to be reported up the management structure to be reviewed at the corporate level. This helps to centralize management efforts across the geographically vast jurisdiction of the agency, and relies largely on cross-coordination between branches and interactions of branch managers. However, this high-level approach can be difficult to reflect in low-level asset management decision-making.

INTEGRATION HIGHLIGHTS
- Corporate-level risk process which reaches across agency branches.
- Performance measures are reported upwards, being assessed at the corporate level; this is difficult to turn into low-level practices.
- Consider measures of economic benefits, driver exposure, congestion, and more.

DATA NEEDS

MRWA maintains a corporate database which contains geometric data on all roads as well as deterioration data, crash data, and more. Additionally, they have implemented a maintenance management system which helps prioritize maintenance projects and supports economic analyses. Additionally, traffic and similar data are collected internally by performance management staff. In recent years, MRWA has made strong pushes to verify their data, especially geometric data, which largely rely on human updates. Though this is a large effort, the data has been improving over time, with broad staff effort and understanding of the importance of data validation. The agency also maintains a risk management database which includes information which cascades throughout the enterprise.

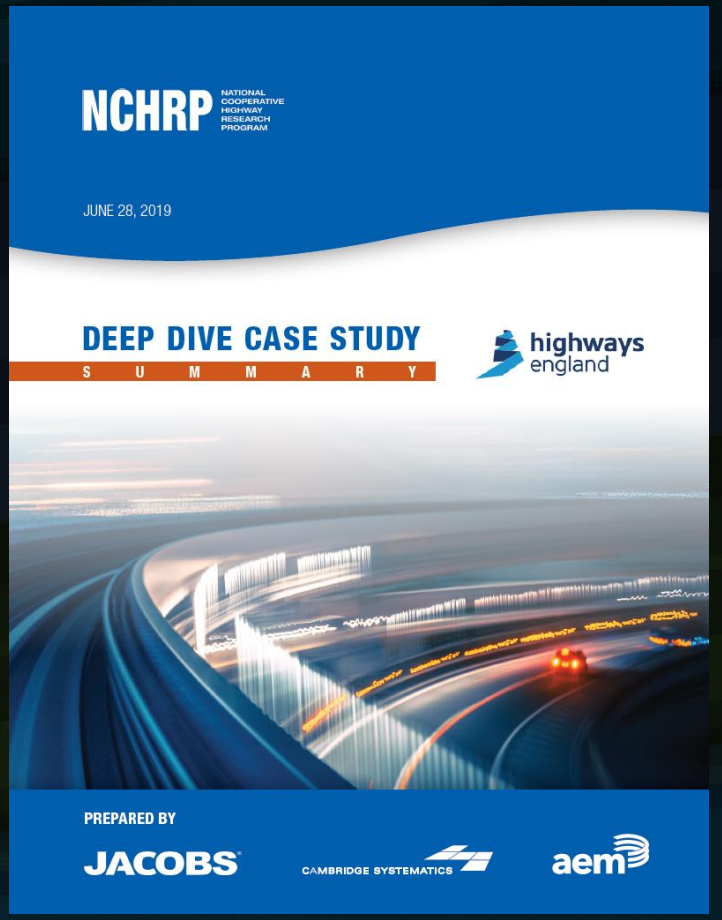
MRWA has implemented software programs such as Microsoft Power BI and Tableau to help with data visualization and to support decision-making processes, and hope to implement more advanced data analysis techniques, such as machine learning, to bring additional efficiencies strengths to their analysis programs.

KEY DATA NEEDS
- It is vital to validate data, ensuring quality and accuracy of information on which decisions are being made.
- Data visualization using tools such as Power BI and Tableau help with decision-making.
- Modern data analysis methods such as machine learning may play a role in the future.

CAMBRIDGE SYSTEMATICS

Deep Dive Case Studies Enabled Research Team to Extensively Interview Leading Agencies

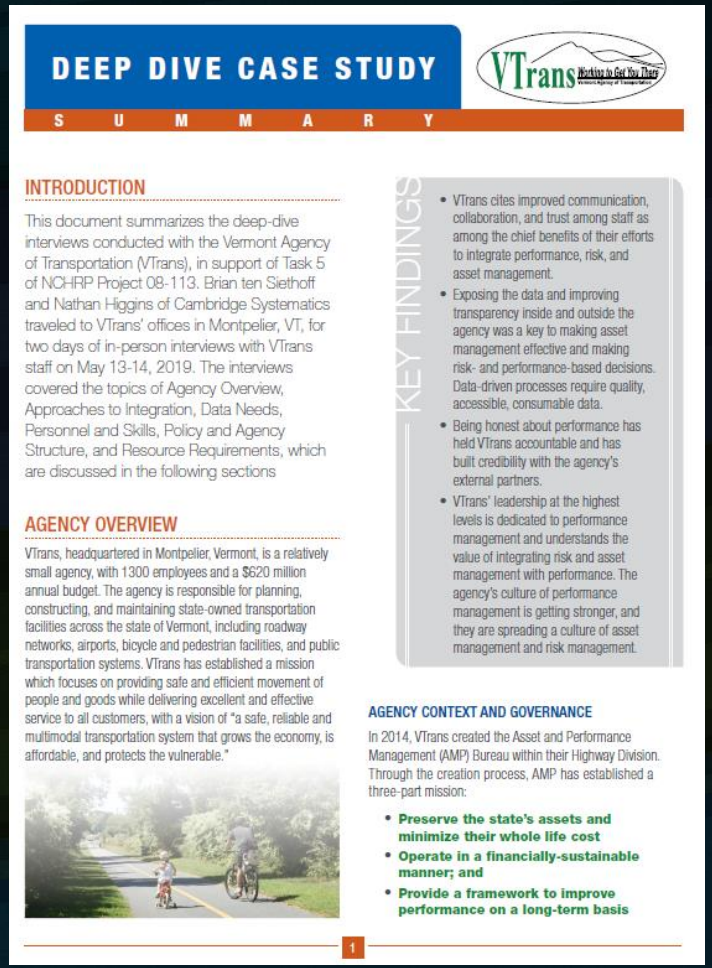
- Interviewed 4 different agencies
  - Atlanta Airlines Terminal Company
  - Caltrans (California DOT)
  - VTrans (Vermont DOT)
  - Highways England
- In-depth summaries
  - Based on extensive in-person and phone interviews
  - Provide comprehensive assessment of each agency's history and approach to integrating asset, performance, and risk management



CAMBRIDGE SYSTEMATICS

The Quick Scans and Deep Divers Uncovered Common Themes

- Executive support has been a key success factor (including elected officials)
- Clear lead and coordination roles in the organization important (and some have Program Management Office)
- Creation and dissemination of core policies with documentation on key performance indicators can help formalize integration
- Culture shift takes time and training
- Trust and relationships are key to long-term success of integration
- Integration requires sustained executive attention and an iterative approach to continuous improvement



DEEP DIVE CASE STUDY

VTrans

SUMMARY

INTRODUCTION

This document summarizes the deep-dive interviews conducted with the Vermont Agency of Transportation (VTrans), in support of Task 5 of NCHRP Project 08-113. Brian ten Siethoff and Nathan Higgins of Cambridge Systematics traveled to VTrans' offices in Montpelier, VT, for two days of in-person interviews with VTrans staff on May 13-14, 2019. The interviews covered the topics of Agency Overview, Approaches to Integration, Data Needs, Personnel and Skills, Policy and Agency Structure, and Resource Requirements, which are discussed in the following sections

AGENCY OVERVIEW

VTrans, headquartered in Montpelier, Vermont, is a relatively small agency, with 1300 employees and a $620 million annual budget. The agency is responsible for planning, constructing, and maintaining state-owned transportation facilities across the state of Vermont, including roadway networks, airports, bicycle and pedestrian facilities, and public transportation systems. VTrans has established a mission which focuses on providing safe and efficient movement of people and goods while delivering excellent and effective service to all customers, with a vision of "a safe, reliable and multimodal transportation system that grows the economy, is affordable, and protects the vulnerable."

KEY FINDINGS

- VTrans cites improved communication, collaboration, and trust among staff as among the chief benefits of their efforts to integrate performance, risk, and asset management.
- Exposing the data and improving transparency inside and outside the agency was a key to making asset management effective and making risk- and performance-based decisions. Data-driven processes require quality, accessible, consumable data.
- Being honest about performance has held VTrans accountable and has built credibility with the agency's external partners.
- VTrans' leadership at the highest levels is dedicated to performance management and understands the value of integrating risk and asset management with performance. The agency's culture of performance management is getting stronger, and they are spreading a culture of asset management and risk management.

AGENCY CONTEXT AND GOVERNANCE

In 2014, VTrans created the Asset and Performance Management (AMP) Bureau within their Highway Division. Through the creation process, AMP has established a three-part mission:

- **Preserve the state's assets and minimize their whole life cost**
- **Operate in a financially-sustainable manner; and**
- **Provide a framework to improve performance on a long-term basis**

1

CAMBRIDGE SYSTEMATICS

The Deep Dives Unearthed History: How Did We Get Here?

- Vermont: “Road to Affordability” in 2006, ARRA in 2009, and TS Irene in 2011 were triggers
  - » Today’s VTransparency initiative has established credibility within and outside the organization
  - » Six asset management task forces overseen by AMP lead
- Caltrans started with six-month business process mapping by Lean Six Sigma group; SB 1 in 2017 provides $5B/year
  - » CA State Highway Operation and Protection Program (SHOPP) has established 34 performance objectives, builds on TAMP to integrate operational vulnerabilities and environmental risks
- Data Governance and improved data and analysis tools have been keys to success

Quick Scans and Deep Dives Highlighted Importance of People, Processes, and Technologies

- Personnel & Skills:
  - Multi-disciplinary staff and cross-silo cooperation
  - Modern technology, data, statistical systems and practices
  - Knowledge transfer between consultants and agency staff
- Policy & Agency Structure:
  - Integration champion
  - Modified organizational structure and documentation to support integration
- Resource Requirements:
  - Combined budgets for integrated management areas
  - Flexible program planning to account for funding variability

Quick Scans and Deep Dives Highlighted Importance of People, Processes, and Technologies

- Data Needs:
  - Institutionalized data governance
  - Visualization and interactive dashboards to empower leadership to engage with technical staff
  - Intentional acquisition, management of high quality asset, financial data
  - Continual improvement of data, sophisticated modeling to account for missing data and uncertainty

THANK YOU!

CAMBRIDGE SYSTEMATICS