Transportation Asset Management Webinar Series

Webinar 33

Highlights from the 12th National Conference on Transportation Asset Management

Sponsored by FHWA and AASHTO

U.S. Department of Transportation
Federal Highway Administration

AASHTO
The Voice of Transportation

Webinar 33 – September 12, 2018

FHWA-AASHTO Asset Management Webinar Series

- This is the 33rd in a webinar series that has been running since 2012
- Webinars are held every two months, on topics such as off-system assets, asset management plans, asset management and risk management, and more
- We welcome ideas for future webinar topics and presentations
- Submit your questions using the webinar's Q&A feature

Welcome

- FHWA and the AASHTO Sub-Committee on Asset Management are pleased to sponsor this webinar
- Sharing knowledge is a critical component of advancing asset management practice

Learning Objectives

- Building working knowledge of key concepts and definitions relevant to transportation asset management
- Beginning to apply this knowledge in the context of the 2018 TRB TAM Conference:
  - What innovative tools are available to enhance TAM at my agency?
  - What benefits can my agency expect by applying leading practices to our asset management program?
  - What are key lessons-learned for agencies seeking to strengthen TAM capabilities?

- **SHARE LESSONS LEARNED, IDEAS, KNOWLEDGE!!!**

Webinar Agenda

2:00 **Webinar Introduction and Overview**
Hyun-A Park (Spy Pond Partners, LLC)

2:05 **Webinar Introduction**
Laura Mester (Michigan DOT)

2:15 **Analyzing and Optimizing Investment**
Scott Richrath (Atkins)

2:35 **Transit**
Laura Zale (SEPTA)

2:55 **TAMPs**
Matthew Haubrich (Iowa DOT)

3:15 **Q&A and Wrap Up**

The 12th National Conference on Transportation Asset Management

Also included:

- FHWA Peer Exchange
- FTA Roundtable
- Several Pre-Conference Workshops

The 12th National Conference on Transportation Asset Management

Opened with 3 member panel discussion:

- **Laurie Berman** – Director CALTRANS
- **Gregory Kildare** – Chief Risk Safety and Asset Management Officer – LA County MTA
- **Kenneth Perry** – Director Office of Planning – FHWA

Featured a wide variety of topic tracks

- You will hear from three track leads today

The 12th National Conference on Transportation Asset Management

Learn More!

Online program with links to presentations, posters, and more:

http://onlinepubs.trb.org/onlinepubs/Conferences/2018/AssetManagement/Agenda.pdf

AASHTO/FHWA TAM Webinar 33

TRB Conference Highlights

Scott Richrath

Atkins, a member of the SNC-Lavalin Group

September 10, 2018

TRB Conference Highlights:
Analyzing & Optimizing Investments

Our Sessions

Trade Offs – 10 "rapid fire" presentations

Tools – 8 "rapid fire" presentations

Connecting Research to Application

Discussion Session on Bridging the Research/Implementation Gaps

Resources for Asset Managers

Optimizing Investments Panel

TRB Conference Highlights:
Analyzing & Optimizing Investments

Trends

Following the Money

Involving our Customers

Managing Risk

TRB Conference Highlights:
Analyzing & Optimizing Investments

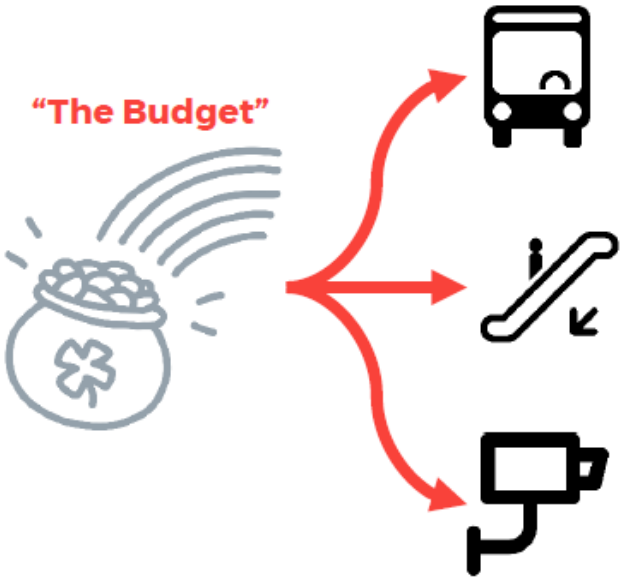
Following the Money

Following the Money: TERM Lite

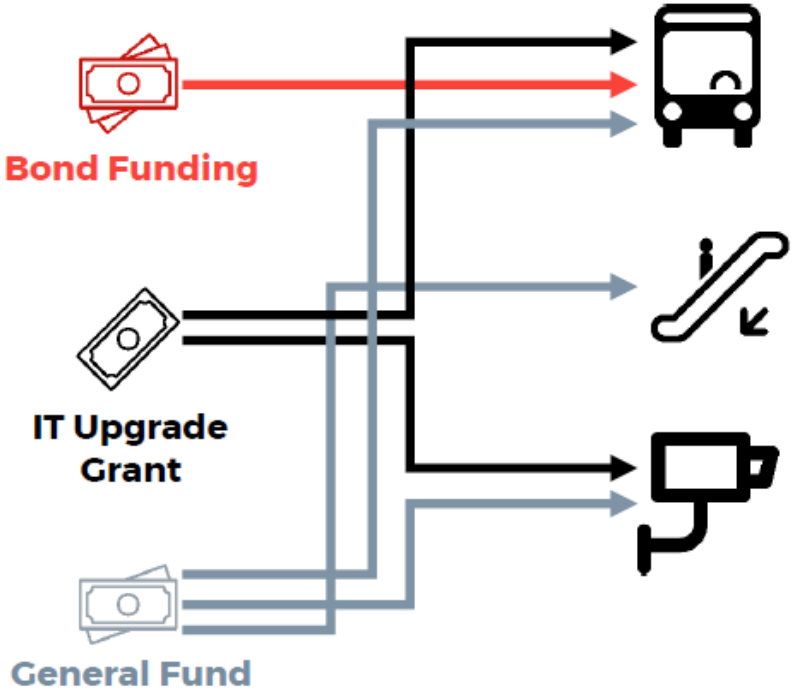
At a glance

Where is The Disconnect?

TERM Lite's Funding Model



Actual Agency Funding



Following the Money: TransLink

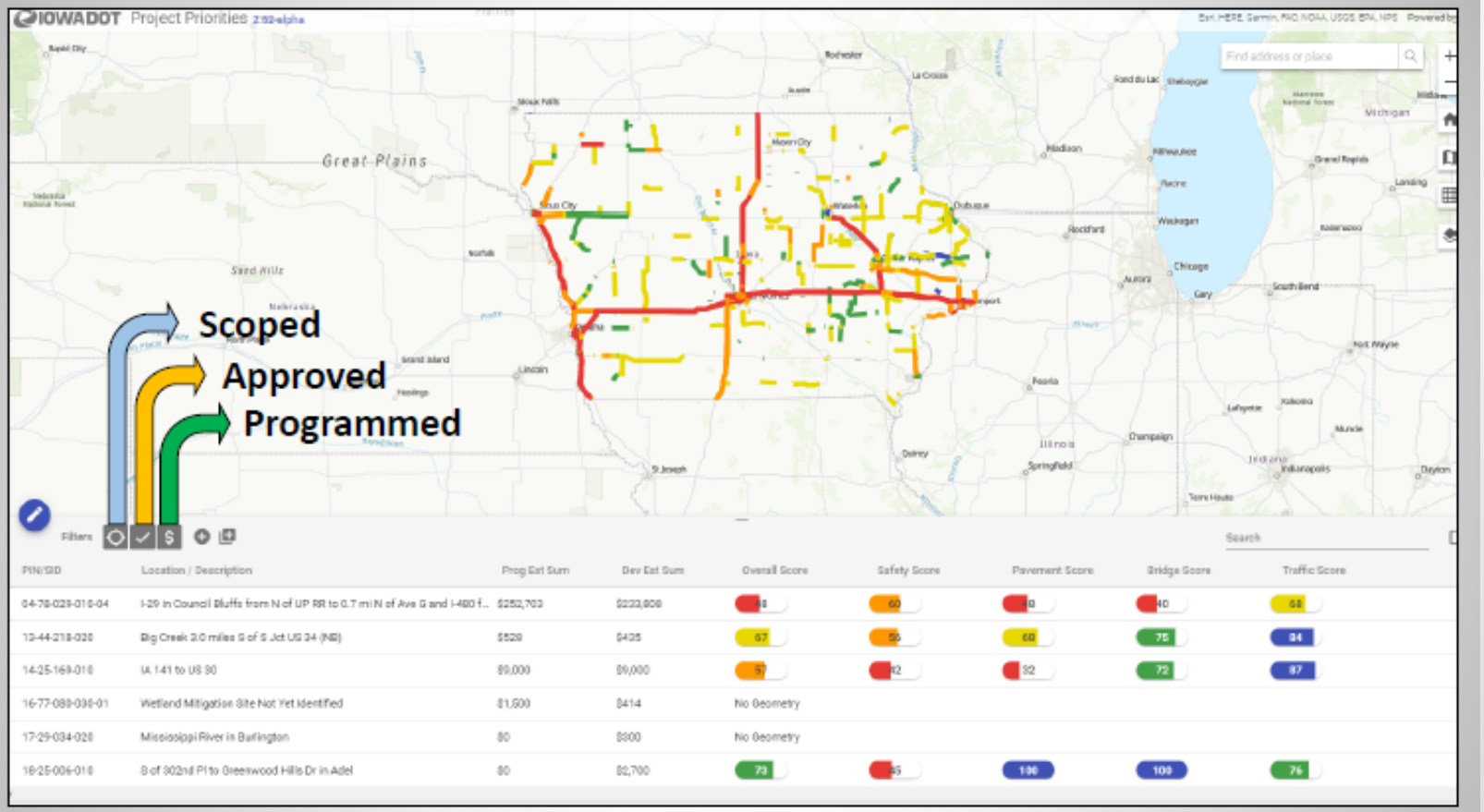
Which Capital Project Asks to Fund?

Decision Support Framework:

- ✓ Consistent framework
- ✓ Justifiable
- ✓ Align with Corporate Priorities

Following the Money: Iowa

Project Prioritization



PIN/SID	Location / Description	Prog Est Sum	Dev Est Sum	Overall Score	Safety Score	Pavement Score	Bridge Score	Traffic Score
04-78-029-010-04	I-29 in Council Bluffs from N of UP RR to 0.7 mi N of Ave G and I-480 f...	$252,703	$233,809	58	60	60	40	68
12-44-218-020	Big Creek 3.0 miles S of S Jct US 34 (NB)	$520	$425	67	55	60	75	84
14-25-169-010	IA 141 to US 30	$9,000	$9,000	57	42	32	72	87
16-77-089-030-01	Wetland Mitigation Site Not Yet Identified	$1,500	$414	No Geometry				
17-29-034-020	Mississippi River in Burlington	$0	$800	No Geometry				
18-25-006-010	S of 302nd Pl to Greenwood Hills Dr in Adel	$0	$2,700	73	45	100	100	76

IOWADOT

Following the Money: Ohio

Web-based Interactive Decision Support

TRB Conference Highlights:
Analyzing & Optimizing Investments

Involving our Customers

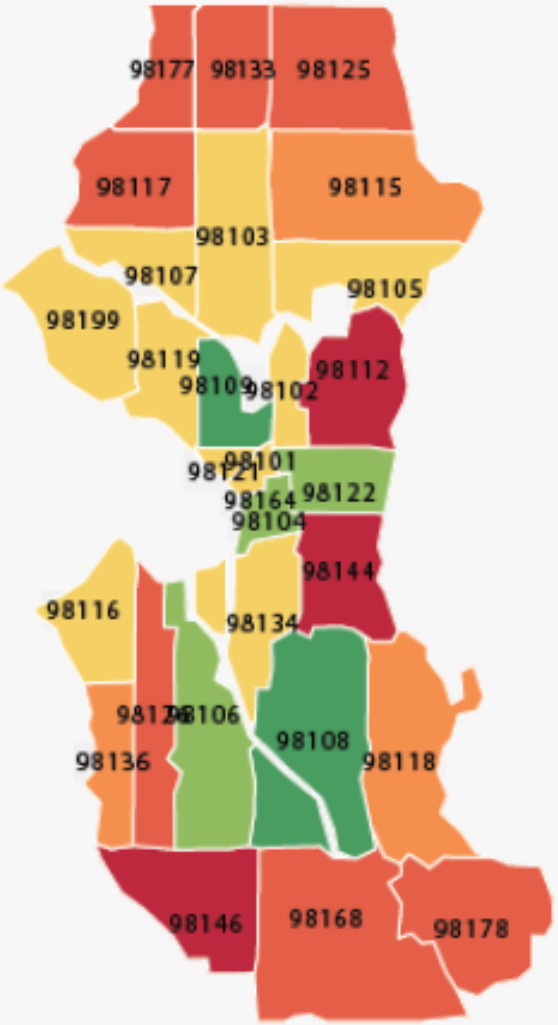
Involving our Customers: TCRP Projects

SGR Return on Investment Calculator

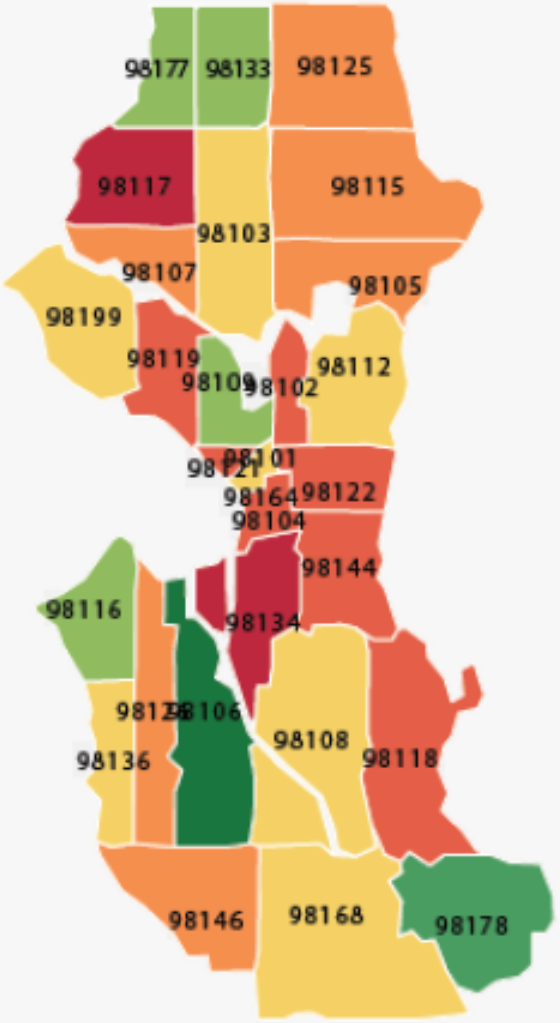
- Research now underway through TCRP Project E-12
- Includes:
  - Guidance development
  - ROI calculation tool
  - Pilot studies
- Builds on prior SGR research, while incorporating additional concepts – e.g., economic impacts, changes in ridership
- Expected completion in 2018
- Team members: SPP, AECOM, MMC, OSU

Involving our Customers: Perception Gap in Seattle

SIDEWALK REPAIR



BICYCLE AND PEDESTRIAN SAFETY



Involving our Customers at NYMTA

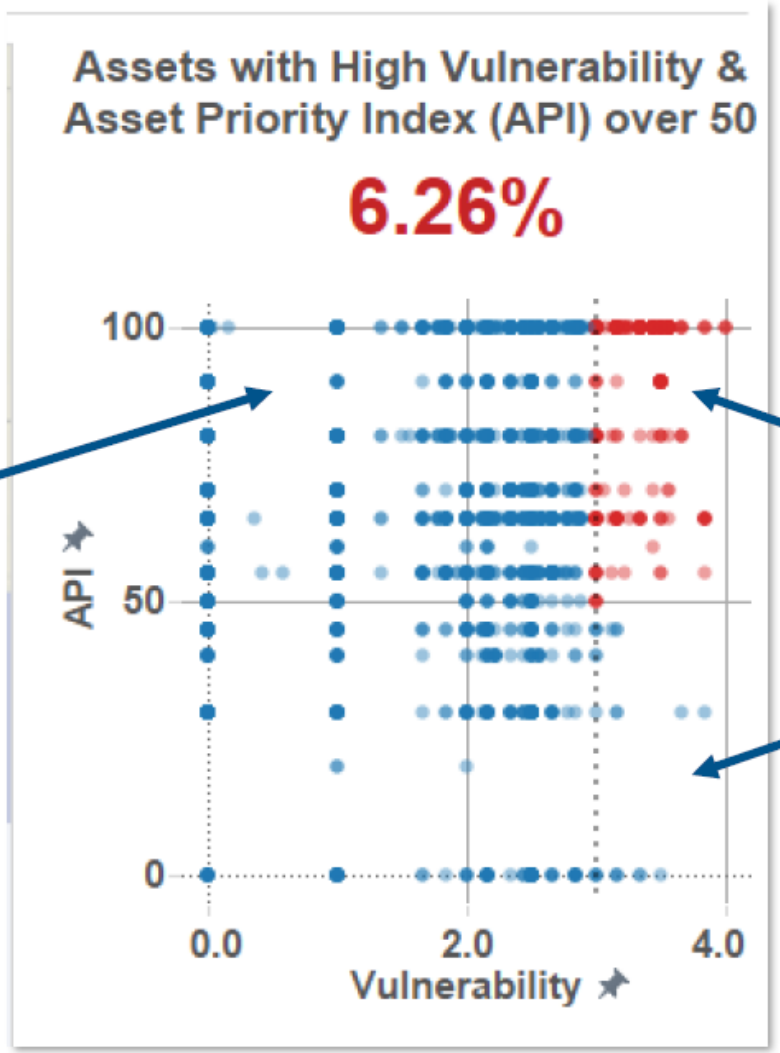
Subways	1982	TODAY*
•Ridership (in millions)	989	1,727
•On Time Performance	50%	63%
•Train Delays	319,500	83,167
•MDBF (miles)	10,800	121,220
•Major Felonies	17,497	211
Buses		
•Ridership (in millions)	585	603
•Pull-out Performance	n/a	99%
•MDBF (miles)	2,466	6,484
Long Island Rail Road		
•Ridership (in millions)	71	89
•On Time Performance	87%	92%
•MDBF (miles)	16,168	205,270
Metro-North Railroad		
•Ridership (in millions)	49	87
•On Time Performance	81%	94%
•MDBF (miles)	18,520	193,883

*Data as of December 2017

TRB Conference Highlights:
Analyzing & Optimizing Investments

Managing Risk

Managing Risk: US Fish & Wildlife



Business-as-usual investment and maintenance strategy

Candidates for risk mitigation investments

Candidates for divestment or decommissioning

TRB Conference Highlights:

Analyzing & Optimizing Investments

Scott Richrath

Atkins, a member of the SNC-Lavalin Group

Scott.Richrath@atkinsglobal.com

Lessons Learned from Transit Practitioners

Laura J. Zale
Southeastern Pennsylvania Transportation Authority

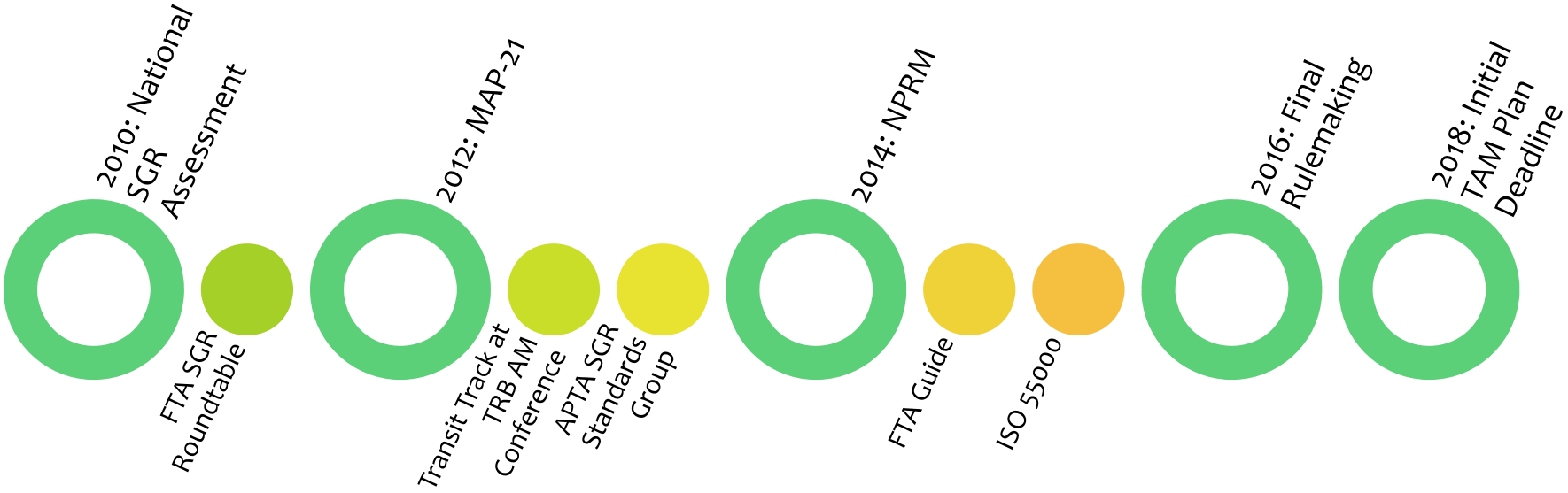
Setting the Stage for Transit

* Multimodal
  * Bus, Trolley, Commuter Rail, Ferry, Heavy Rail, Demand Response
* Diverse Asset Portfolios
  * Vehicles, Equipment, Facilities, Power and Train Control Systems, Interlockings, Grade Crossings, Bridges, Tunnels
* Operate in Shared Right-of-Way
* Legacy and Middle Aged Properties

Challenges Similar to Those of our DOT Partners

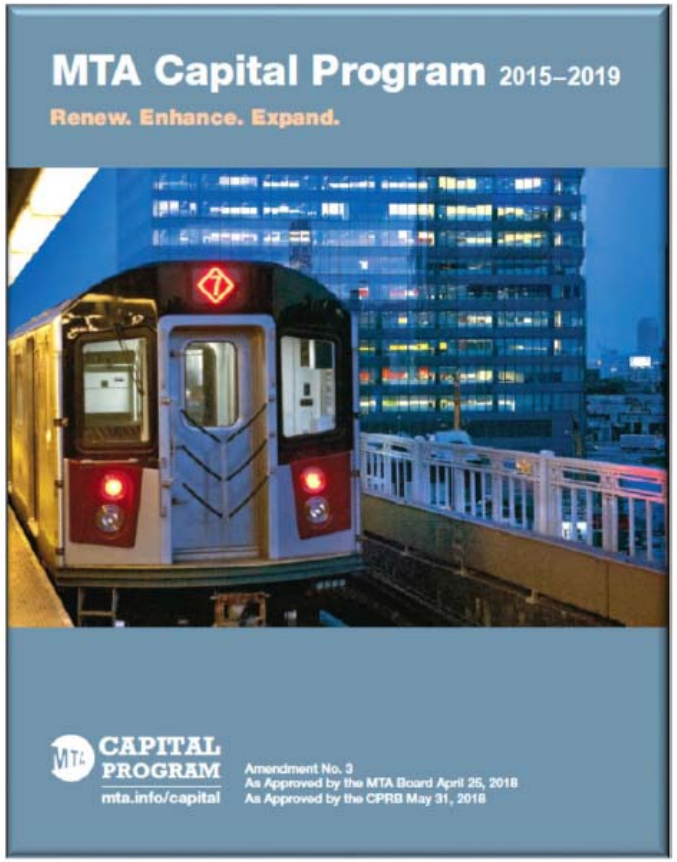
* Meeting Current and Future Demand
* Maintaining Existing System
* Assessing Risk
* Constrained Funding

Evolution of Transit Asset Management Practice



Evolution of Transit Asset Management Practice

* Practice has evolved rapidly over 6 years
* Full time function at an agency
* Standards development
  * FTA, APTA
* Benchmarking



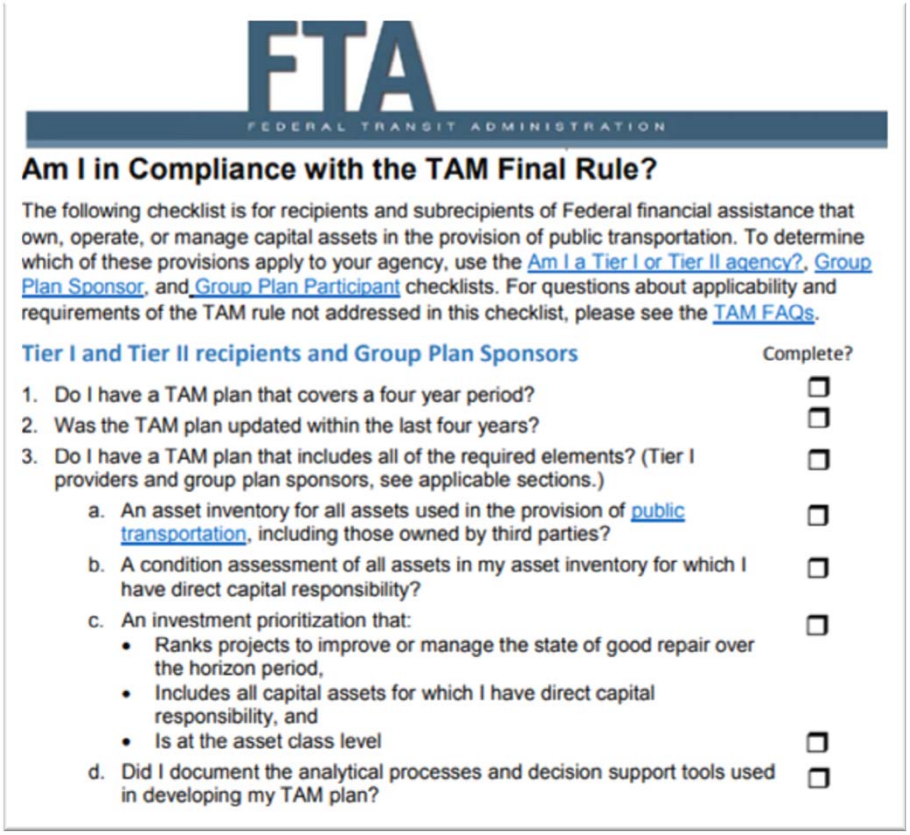
Transit Track Themes

* Compliance
* Communication
* Culture
* Consequences

TRANSIT
ASSET
MANAGEMENT

FTA Perspective

* Review Process
  * Not submitted to the FTA
* Technical Resources (transit.dot.gov/TAM)
* FAQ Page



FTA

FEDERAL TRANSIT ADMINISTRATION

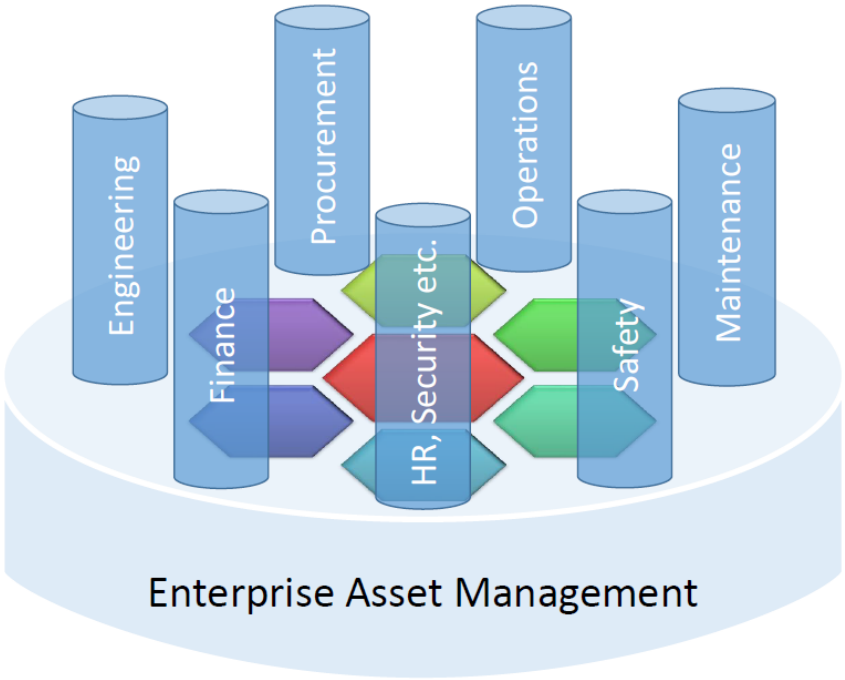
Am I in Compliance with the TAM Final Rule?

The following checklist is for recipients and subrecipients of Federal financial assistance that own, operate, or manage capital assets in the provision of public transportation. To determine which of these provisions apply to your agency, use the Am I a Tier I or Tier II agency?, Group Plan Sponsor, and Group Plan Participant checklists. For questions about applicability and requirements of the TAM rule not addressed in this checklist, please see the TAM FAQs.

Tier I and Tier II recipients and Group Plan Sponsors	Complete?
1. Do I have a TAM plan that covers a four year period?	☐
2. Was the TAM plan updated within the last four years?	☐
3. Do I have a TAM plan that includes all of the required elements? (Tier I providers and group plan sponsors, see applicable sections.)	☐
a. An asset inventory for all assets used in the provision of public transportation, including those owned by third parties?	☐
b. A condition assessment of all assets in my asset inventory for which I have direct capital responsibility?	☐
c. An investment prioritization that: • Ranks projects to improve or manage the state of good repair over the horizon period, • Includes all capital assets for which I have direct capital responsibility, and • Is at the asset class level	☐
d. Did I document the analytical processes and decision support tools used in developing my TAM plan?	☐

Sustainable Asset Management

* Executive Buy In
  * Maryland Asset Management Directive
* Implementation of Core Teams
  * BART, MARTA, METRA, and Jacksonville
* Connecting "Cylinders of Excellence" (MTA B&T)



Procurement and TAM

* Procurement and Contracts are integral to whole lifecycle management.

Knowledge Management

* Training
  * BART: Periods of significant hiring and reinvestment in the system coincide
  * SEPTA: New onboarding program
* Training and Change Management

TAM Plan Communication

Where we are with our TAM Plan (Tier I)

TAM Plan Element	Our Status (as of XX/XXXX)	Additional Level of Effort Anticipated
1. Inventory of Capital Assets		
2. Condition Assessment		
3. Decision Support Tools		
4. Investment Prioritization		
5. TAM and SGR Policy		
6. Implementation Strategy		
7. List of Key Annual Activities		
8. Identification of Resources		
9. Evaluation Plan		

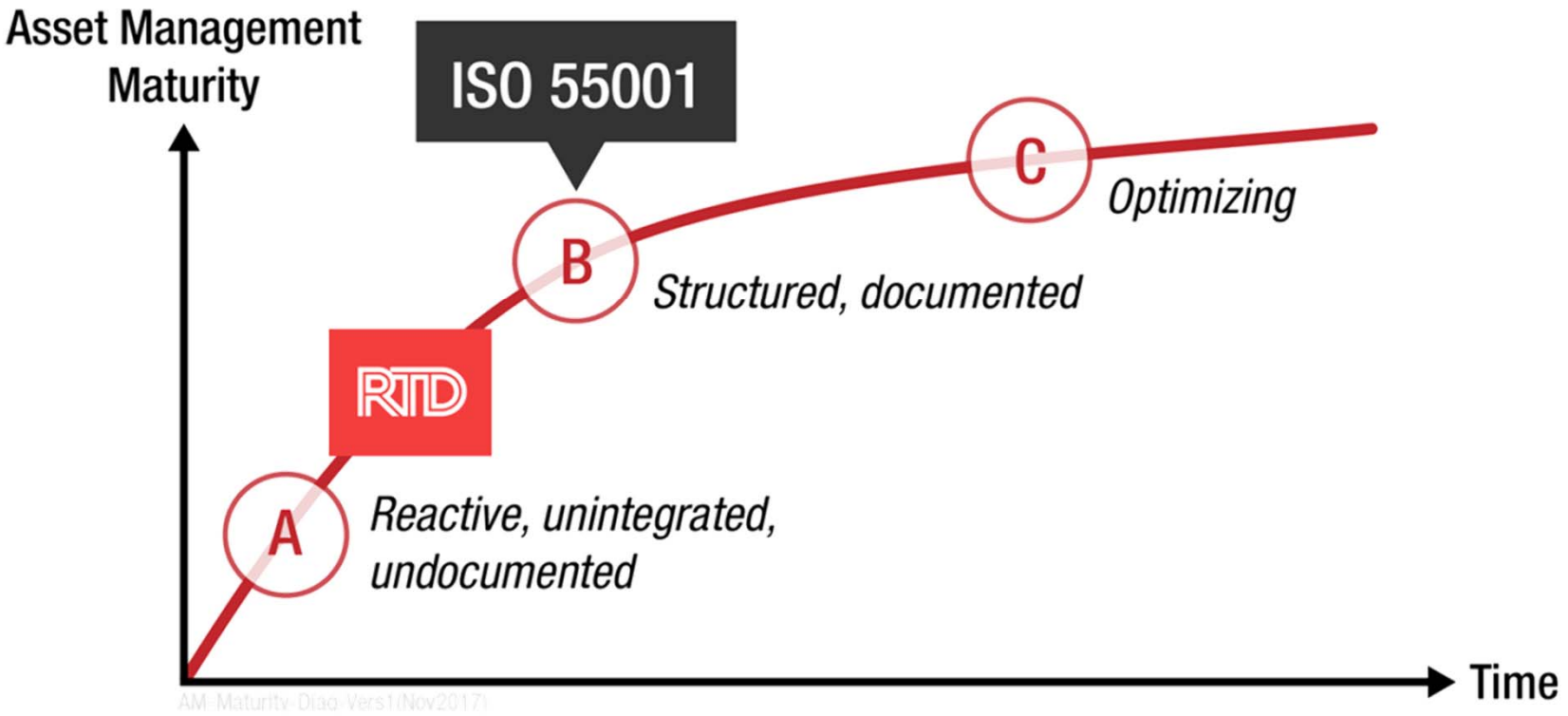
Fill in with your agency's information

Next TAM Plan Due Date: Oct 2018

Benchmarks

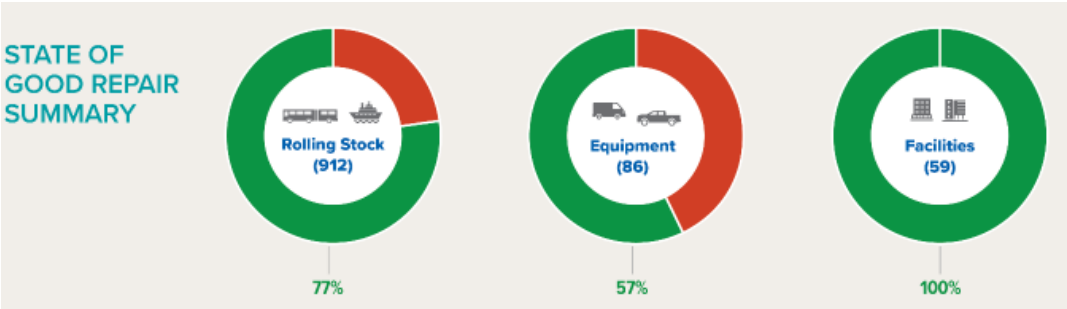
Benchmarks

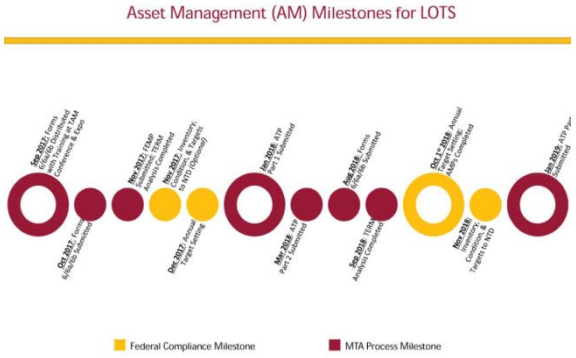
What we found at RTD



Data for Multiple Audiences

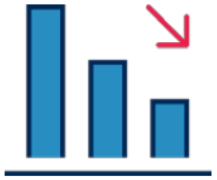
* Challenges for Tier II Operators
  * Development of group TAM Plans
* Software to support data collection
  * VA/ PA collaboration, Iowa, MTC





Multiple Business Functions Rely on a Common Asset Inventory

TAM Plan



FINANCIAL SYSTEM

Fixed asset accounting depreciates assets over time

WORK ORDER SYSTEM

Scheduling maintenance activities

CAPITAL PLANNING

Budgeting future resources in accordance with long range plan

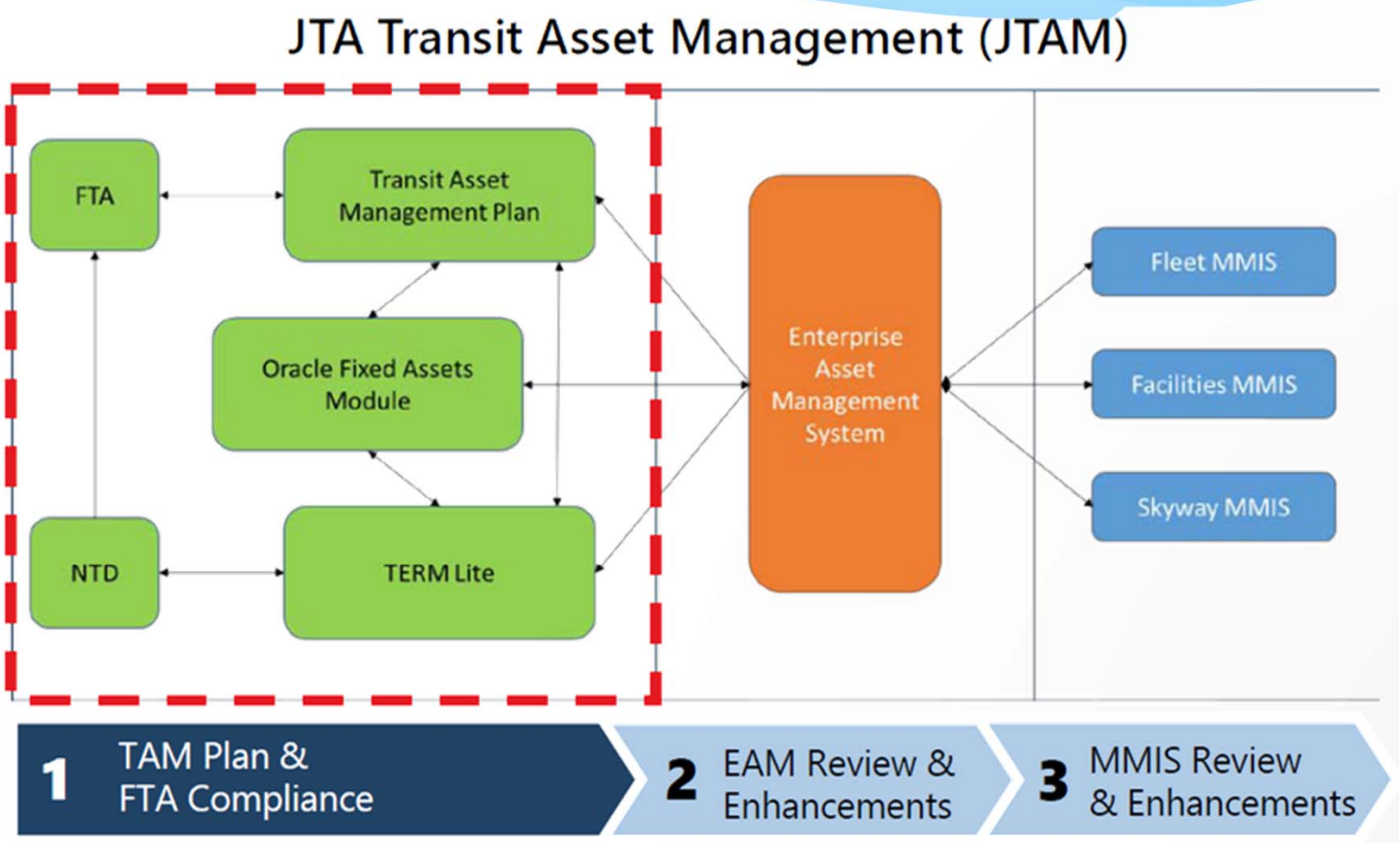
REPORTING REQUIREMENTS

Reporting on transit assets to the National Transit Database (NTD)

These business functions often sit in independent systems and lack a "primary key" to tie all records together to work as a system.

Technology Influences Decision Making

These functions all rely on a common inventory



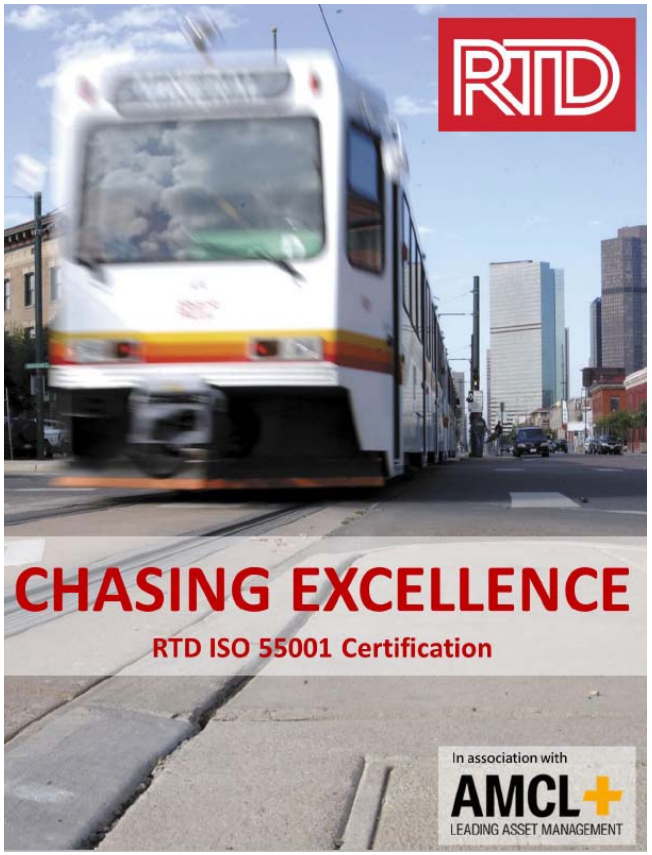
Technology Influences Decision Making

* Development of core teams in selecting software

* Use of technology in data collection

What do we anticipate in 2020?

* Best practices in stakeholder communication
* Demonstrating ROI for Asset Management
* Better informed investments



The Hedgehog Concept

Thank you!

* Track team: Mshadoni Smith, Dave Springstead, John McCormick, and Paul Edwards

* To the 81 attendees of the TAM Roundtable and the 35 agencies who participated in the TRB Conference

12th National Conference on Transportation Asset Management

TAMP Track Summary

Matt Haubrich, Iowa DOT
TAMP Track Leader

Our Eight Sessions

Monday Sessions

1. State DOT TAMP Development
2. Transit Agency TAMP Challenges/Opportunities (Transit Virtual Track)
3. Our Initial TAMP is Done – What Now? (Discussion Session, joint with Implementation Track)
4. Are All Our Plans and Targets Aligned? (Discussion Session)

Tuesday Sessions

5. Group Transit Asset Management Plan Development (Transit Virtual Track)
6. Risk and Resilience in the TAMPs (Resilience Virtual Track)
7. Coordinating Your TAMPs: Addressing Assets You Don't Own and Local Agencies You Don't Own
8. Advancing Practices in Strategic TAMP Development

Track Highlights in Four Areas

1. The Evolving Practice of TAM
2. How Organizational Culture is Adapting
3. How Technology is Influencing Decision-Making
4. How Data is Used to Tell the Story

Evolving Practice of TAM

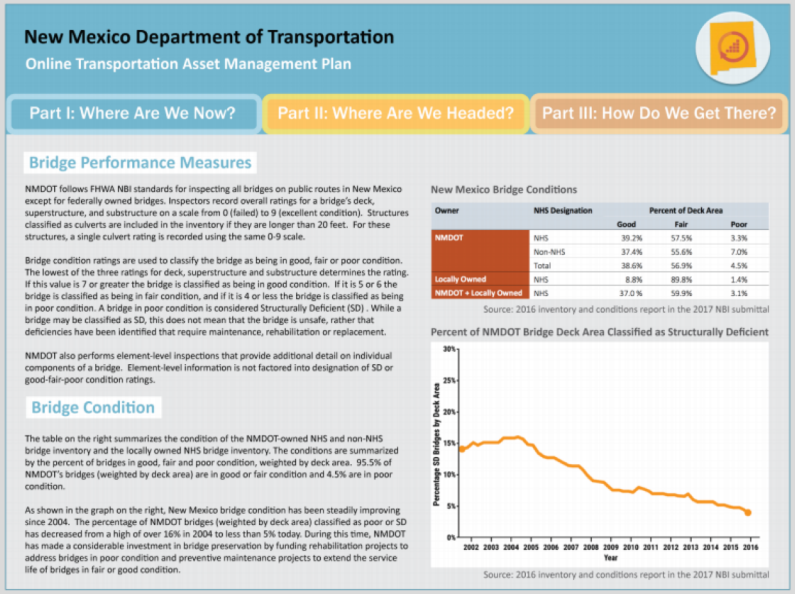
Assets Included – NHS and non-NHS

Asset Classes			
Pavements	Bridges	Culverts	Deep Stormwater Tunnels
High Mast Light Towers	Overhead Sign Structures	Pedestrian Infrastructure	ITS
Noise Walls	Traffic Signals	Roadway Lighting	Buildings

Evolving Practice of TAM

Web-Based TAMP

- Provide easier access for all stakeholders
- Available whenever wanted with use of any browser
- Will be basis for the “living TAMP” that supports a continuous improvements approach



New Mexico Department of Transportation

Online Transportation Asset Management Plan

Part I: Where Are We Now? | Part II: Where Are We Headed? | Part III: How Do We Get There?

Bridge Performance Measures

NMDOT follows FHWA NBI standards for inspecting all bridges on public routes in New Mexico except for federally owned bridges. Inspectors record overall ratings for a bridge's deck, superstructure, and substructure on a scale from 0 (failed) to 9 (excellent condition). Structures classified as culverts are included in the inventory if they are longer than 20 feet. For these structures, a single culvert rating is recorded using the same 0-9 scale.

Bridge condition ratings are used to classify the bridge as being in good, fair or poor condition. The lowest of the three ratings for deck, superstructure and substructure determines the rating. If this value is 7 or greater the bridge is classified as being in good condition. If it is 5 or 6 the bridge is classified as being in fair condition, and if it is 4 or less the bridge is classified as being in poor condition. A bridge in poor condition is considered Structurally Deficient (SD) . While a bridge may be classified as SD, this does not mean that the bridge is unsafe, rather that deficiencies have been identified that require maintenance, rehabilitation or replacement.

NMDOT also performs element-level inspections that provide additional detail on individual components of a bridge. Element-level information is not factored into designation of SD or good-fair-poor condition ratings.

Bridge Condition

The table on the right summarizes the condition of the NMDOT-owned NHS and non-NHS bridge inventory and the locally owned NHS bridge inventory. The conditions are summarized by the percent of bridges in good, fair and poor condition, weighted by deck area. 95.5% of NMDOT's bridges (weighted by deck area) are in good or fair condition and 4.5% are in poor condition.

As shown in the graph on the right, New Mexico bridge condition has been steadily improving since 2004. The percentage of NMDOT bridges (weighted by deck area) classified as poor or SD has decreased from a high of over 16% in 2004 to less than 5% today. During this time, NMDOT has made a considerable investment in bridge preservation by funding rehabilitation projects to address bridges in poor condition and preventive maintenance projects to extend the service life of bridges in fair or good condition.

New Mexico Bridge Conditions

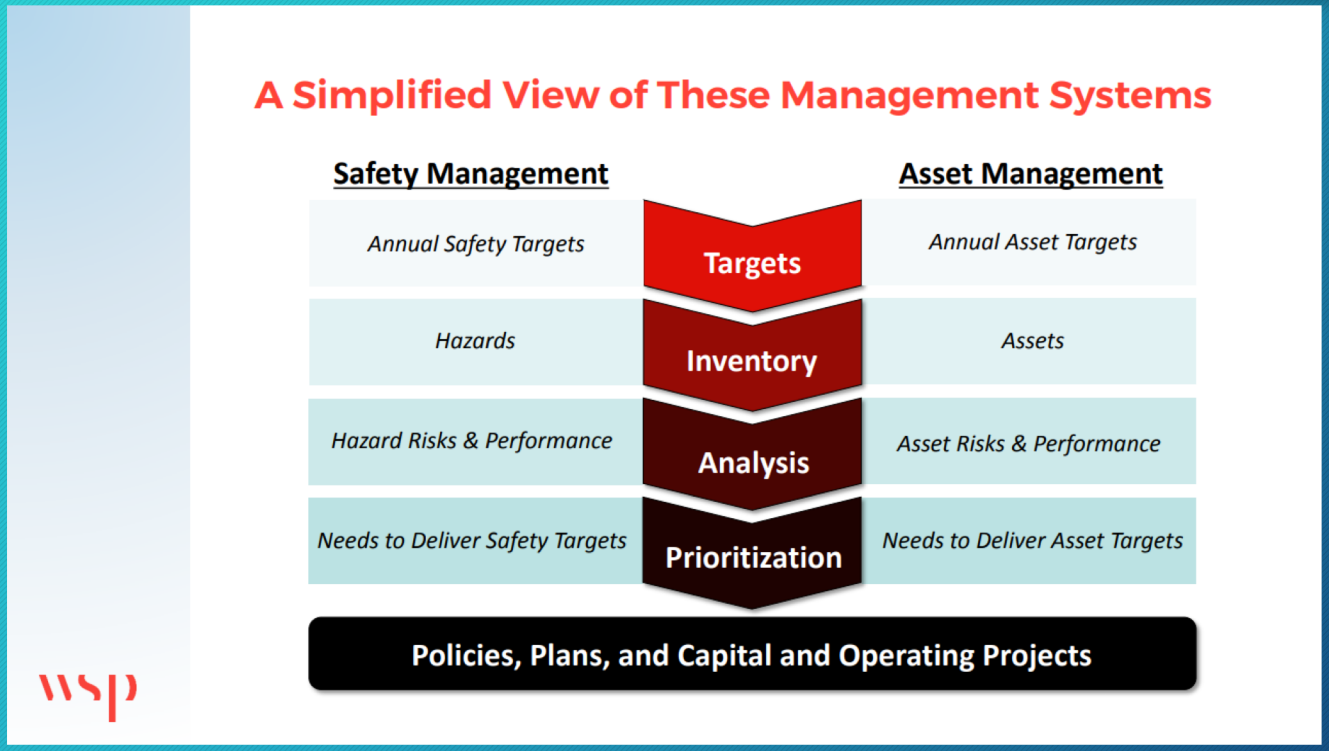
Owner	NHS Designation	Percent of Deck Area		
		Good	Fair	Poor
NMDOT	NHS	39.2%	57.5%	3.3%
	Non-NHS	37.4%	55.6%	7.0%
	Total	38.6%	56.9%	4.5%
Locally Owned	NHS	8.8%	89.8%	1.4%
NMDOT + Locally Owned	NHS	37.0 %	59.9%	3.1%

Source: 2016 inventory and conditions report in the 2017 NBI submittal

Percent of NMDOT Bridge Deck Area Classified as Structurally Deficient

Source: 2016 inventory and conditions report in the 2017 NBI submittal

Evolving Practice of TAM



Evolving Practice of TAM

Evolving Practice of TAM

- Connecticut and Minnesota DOTs talked about incorporating assets beyond pavements and bridges.
- New Mexico's "Online TAMP" to make the TAM Plan more accessible and actionable within their DOT.
- WSP shared perspectives on the relationship between TAM and Safety management.
- AP Tech talked about how we're incorporating resilience into our decision-making.
- To align targets across owners sometimes requires thinking outside the box, such as Michigan DOT's approach of supporting pavement management software and practices for local agencies. (Discussion Session)

Organizational Culture is Changing

Integrating MPOs, Cities and Counties

WSDOT/MPO: Mapping the MAP-21 target setting process

Target setting framework group: This group includes WSDOT and MPO directors and is responsible for making final determinations.

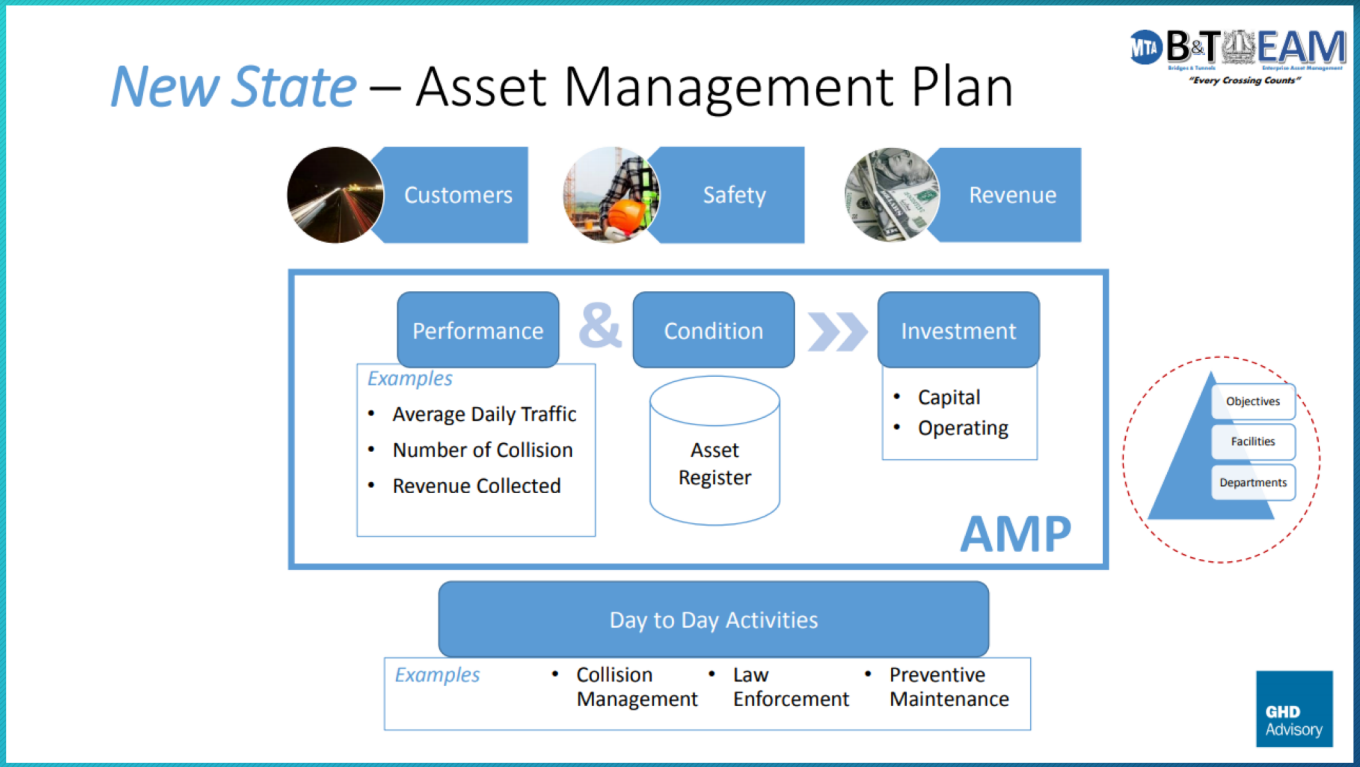
Internal WSDOT technical group: This group includes WSDOT technical team members and is responsible for MAP-21 implementation from technical standpoint such as

1. Defining reporting segments
2. Conflation
3. Metric calculation
4. Measure calculation
5. Target development
6. Develop report to meet federal requirement...
7. ... and other detailed work

Target setting working group: This group includes all the MPO personnel with technical expertise along with WSDOT technical experts and is responsible for developing and agreeing on various attributes related to PM3 MAP-21 performance reporting. MPO delegates of the group will decide to adopt WSDOT developed targets or if they are going to set their own targets.

Target setting technical team: This group includes technical staff from WSDOT and MPOs and are responsible for agreeing on targets and to develop consensus.

Organizational Culture is Changing

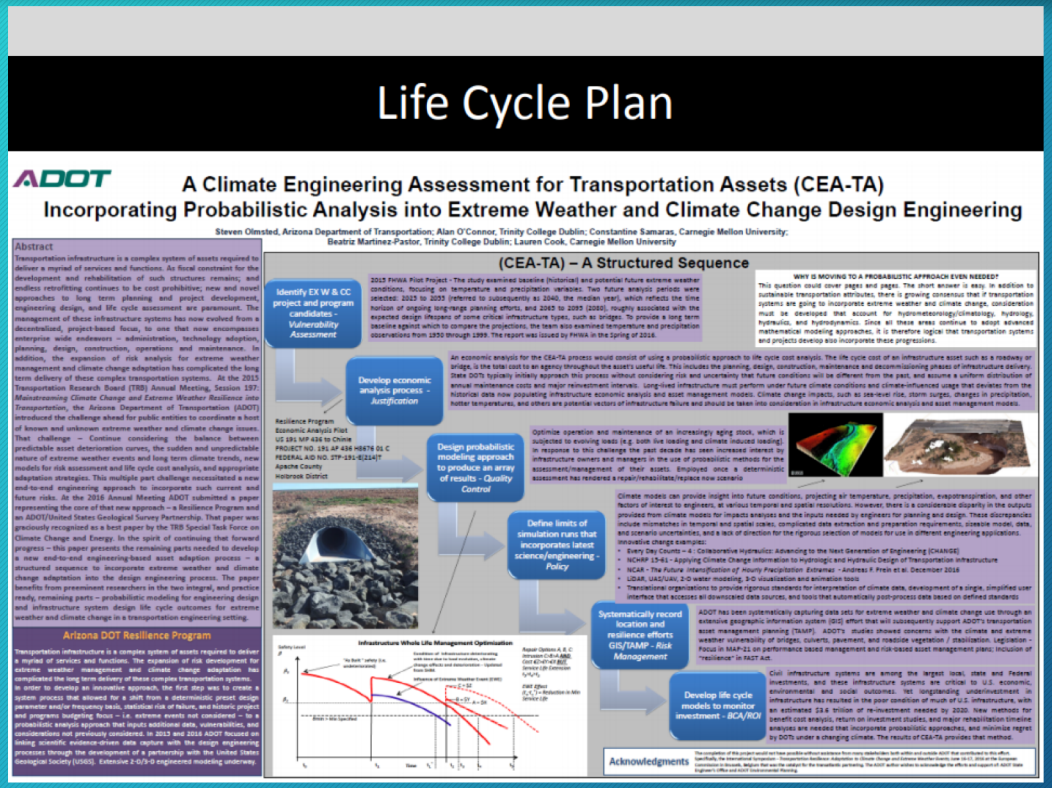


Organizational Culture is Changing

- Within the state of Washington, much work went into coordinating with local agencies and MPOs to set targets.
- New York MTA talked about transforming their entire organization to a new business model designed to break down the “silos” and improve decision-making.
- One DOT talked about how interaction with local agencies has expanded, challenging both sides to walk in the shoes of the other. (Discussion Session)
- Texas talked about how the work to develop their TAM Plan led to greater understanding across the organization of the project selection and programming process. (Discussion Session)

Technology Influences Decision-Making

Life Cycle Plan



ADOT

A Climate Engineering Assessment for Transportation Assets (CEA-TA)
Incorporating Probabilistic Analysis into Extreme Weather and Climate Change Design Engineering

Steven Olmsted, Arizona Department of Transportation; Alan O'Connor, Trinity College Dublin; Constantine Samaras, Carnegie Mellon University;
Beatriz Martinez-Pastor, Trinity College Dublin; Lauren Cook, Carnegie Mellon University

Abstract

Transportation infrastructure is a complex system of assets required to deliver a myriad of services and functions. As fiscal constraint for the development and rehabilitation of such structures remains; and endless retrofitting continues to be cost prohibitive; new and novel approaches to long term planning and project development, engineering design, and life cycle assessment are paramount. The management of these infrastructure systems has now evolved from a decentralized, project-based focus, to one that now encompasses enterprise wide endeavors – administration, technology adoption, planning, design, construction, operations and maintenance. In addition, the expansion of risk analysis for extreme weather management and climate change adaptation has complicated the long term delivery of these complex transportation systems. At the 2015 Transportation Research Board (TRB) Annual Meeting, Session 197: *Mainstreaming Climate Change and Extreme Weather Resilience into Transportation*, the Arizona Department of Transportation (ADOT) introduced the challenge ahead for public entities to coordinate a host of known and unknown extreme weather and climate change issues. That challenge – Continue considering the balance between predictable asset deterioration curves, the sudden and unpredictable nature of extreme weather events and long term climate trends, new models for risk assessment and life cycle cost analysis, and appropriate adaptation strategies. This multiple part challenge necessitated a new end-to-end engineering approach to incorporate such current and future risks. At the 2016 Annual Meeting ADOT submitted a paper representing the core of that new approach – a Resilience Program and an ADOT/United States Geological Survey Partnership. That paper was graciously recognized as a best paper by the TRB Special Task Force on Climate Change and Energy. In the spirit of continuing that forward progress – this paper presents the remaining parts needed to develop a new end-to-end engineering-based asset adaption process – a structured sequence to incorporate extreme weather and climate change adaptation into the design engineering process. The paper benefits from preeminent researchers in the two integral, and practice ready, remaining parts – probabilistic modeling for engineering design and infrastructure system design life cycle outcomes for extreme weather and climate change in a transportation engineering setting.

Arizona DOT Resilience Program

Transportation infrastructure is a complex system of assets required to deliver a myriad of services and functions. The expansion of risk development for extreme weather management and climate change adaptation has complicated the long term delivery of these complex transportation systems.

In order to develop an innovative approach, the first step was to create a system process that allowed for a shift from a deterministic preset design parameter and/or frequency basis, statistical risk of failure, and historic project and programs budgeting focus – i.e. extreme events not considered – to a probabilistic analysis approach that inputs additional data, vulnerabilities, and considerations not previously considered. In 2013 and 2014 ADOT focused on linking scientific evidence-driven data capture with the design engineering processes through the development of a partnership with the United States Geological Society (USGS). Extensive 2-D/3-D engineered modeling underway.

(CEA-TA) – A Structured Sequence

Identify EX W & CC project and program candidates - *Vulnerability Assessment*

2015 FHWA Pilot Project - The study examined baseline (historical) and potential future extreme weather conditions, focusing on temperature and precipitation variables. Two future analysis periods were selected: 2025 to 2055 (referred to subsequently as 2040, the median year), which reflects the time horizon of ongoing long-range planning efforts, and 2065 to 2095 (2080), roughly associated with the expected design lifespans of some critical infrastructure types, such as bridges. To provide a long term baseline against which to compare the projections, the team also examined temperature and precipitation observations from 1950 through 1999. The report was issued by FHWA in the Spring of 2016.

WHY IS MOVING TO A PROBABILISTIC APPROACH EVEN NEEDED?

This question could cover pages and pages. The short answer is easy. In addition to sustainable transportation attributes, there is growing consensus that if transportation systems are going to incorporate extreme weather and climate change, consideration must be developed that account for hydrometeorology/climatology, hydrology, hydraulics, and hydrodynamics. Since all these areas continue to adopt advanced mathematical modeling approaches, it is therefore logical that transportation systems and projects develop also incorporate these progressions.

Develop economic analysis process - *Justification*

An economic analysis for the CEA-TA process would consist of using a probabilistic approach to life cycle cost analysis. The life cycle cost of an infrastructure asset such as a roadway or bridge, is the total cost to an agency throughout the asset's useful life. This includes the planning, design, construction, maintenance and decommissioning phases of infrastructure delivery. State DOTs typically initially approach this process without considering risk and uncertainty that future conditions will be different from the past, and assume a uniform distribution of annual maintenance costs and major reinvestment intervals. Long-lived infrastructure must perform under future climate conditions and climate-influenced usage that deviates from the historical data now populating infrastructure economic analysis and asset management models. Climate change impacts, such as sea-level rise, storm surges, changes in precipitation, hotter temperatures, and others are potential vectors of infrastructure failure and should be taken into consideration in infrastructure economic analysis and asset management models.

Resilience Program
Economic Analysis Pilot
US 191 MP 436 to Chinle
PROJECT NO. 191 AP 436 H8676 01 C
FEDERAL AID NO. STP-191-E(214)T
Apache County
Holbrook District

Design probabilistic modeling approach to produce an array of results - *Quality Control*

Optimize operation and maintenance of an increasingly aging stock, which is subjected to evolving loads (e.g. both live loading and climate induced loading). In response to this challenge the past decade has seen increased interest by infrastructure owners and managers in the use of probabilistic methods for the assessment/management of their assets. Employed once a deterministic assessment has rendered a repair/rehabilitate/replace now scenario

Define limits of simulation runs that incorporates latest science/engineering - *Policy*

Climate models can provide insight into future conditions, projecting air temperature, precipitation, evapotranspiration, and other factors of interest to engineers, at various temporal and spatial resolutions. However, there is a considerable disparity in the outputs provided from climate models for impacts analyses and the inputs needed by engineers for planning and design. These discrepancies include mismatches in temporal and spatial scales, complicated data extraction and preparation requirements, sizeable model, data, and scenario uncertainties, and a lack of direction for the rigorous selection of models for use in different engineering applications.

Innovative change examples:

- Every Day Counts – 4 - Collaborative Hydraulics: Advancing to the Next Generation of Engineering (CHANGE)
- NCHRP 15-61 - Applying Climate Change Information to Hydrologic and Hydraulic Design of Transportation Infrastructure
- NCAR - *The Future Intensification of Hourly Precipitation Extremes* - Andreas F. Prein et al. December 2016
- LiDAR, UAS/UAV, 2-D water modeling, 3-D visualization and animation tools
- Translational organizations to provide rigorous standards for interpretation of climate data, development of a single, simplified user interface that accesses all downscaled data sources, and tools that automatically post-process data based on defined standards

Systematically record location and resilience efforts GIS/TAMP - *Risk Management*

ADOT has been systematically capturing data sets for extreme weather and climate change use through an extensive geographic information system (GIS) effort that will subsequently support ADOT's transportation asset management planning (TAMP). ADOT's studies showed concerns with the climate and extreme weather vulnerability of bridges, culverts, pavement, and roadside vegetation / stabilization. Legislation - Focus in MAP-21 on performance based management and risk-based asset management plans; inclusion of "resilience" in FAST Act.

Infrastructure Whole Life Management Optimization

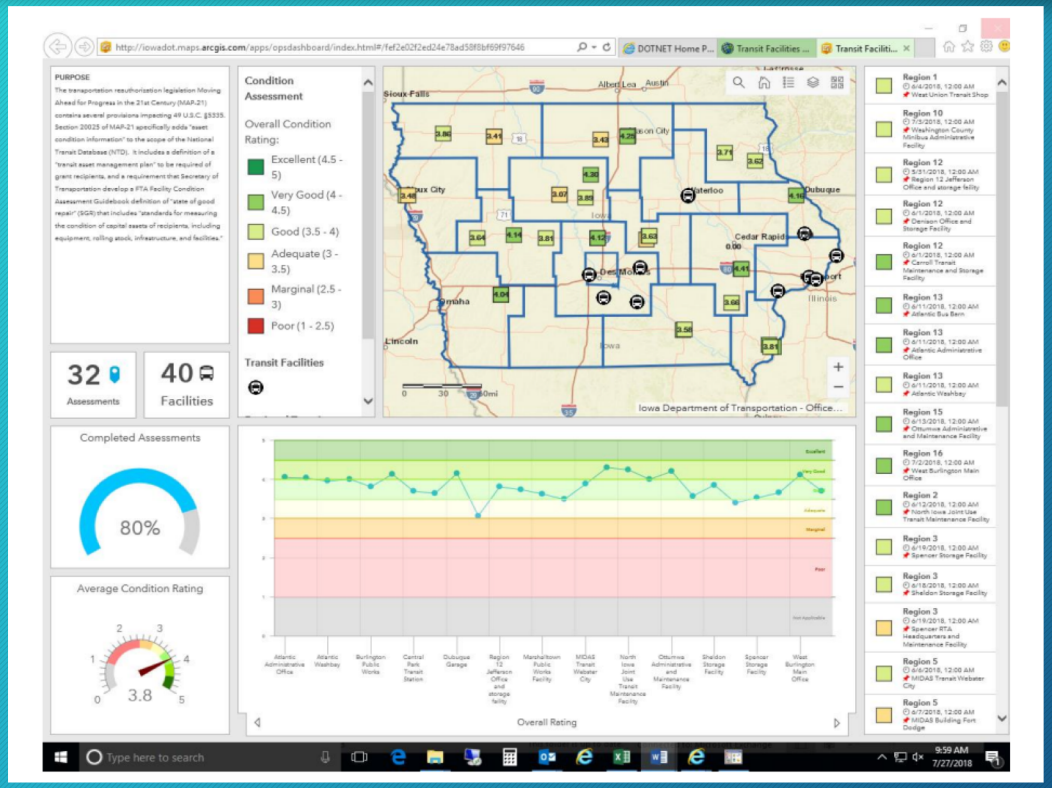
Develop life cycle models to monitor investment - *BCA/ROI*

Civil infrastructure systems are among the largest local, state and federal investments, and these infrastructure systems are critical to U.S. economic, environmental and social outcomes. Yet longstanding underinvestment in infrastructure has resulted in the poor condition of much of U.S. infrastructure, with an estimated $3.6 trillion of re-investment needed by 2020. New methods for benefit cost analysis, return on investment studies, and major rehabilitation timeline analyses are needed that incorporate probabilistic approaches, and minimize regret by DOTs under a changing climate. The results of CEA-TA provides that method.

Acknowledgments

The completion of this project would not have possible without assistance from many stakeholders both within and outside ADOT that contributed to this effort. Specifically, the International Symposium – Transportation Resilience Adaptation to Climate Change and Extreme Weather Events, June 14-17, 2016 at the European Commission in Brussels, Belgium that was the catalyst for the transatlantic partnership. The ADOT author wishes to acknowledge the efforts and support of ADOT State Engineer's Office and ADOT Environmental Planning.

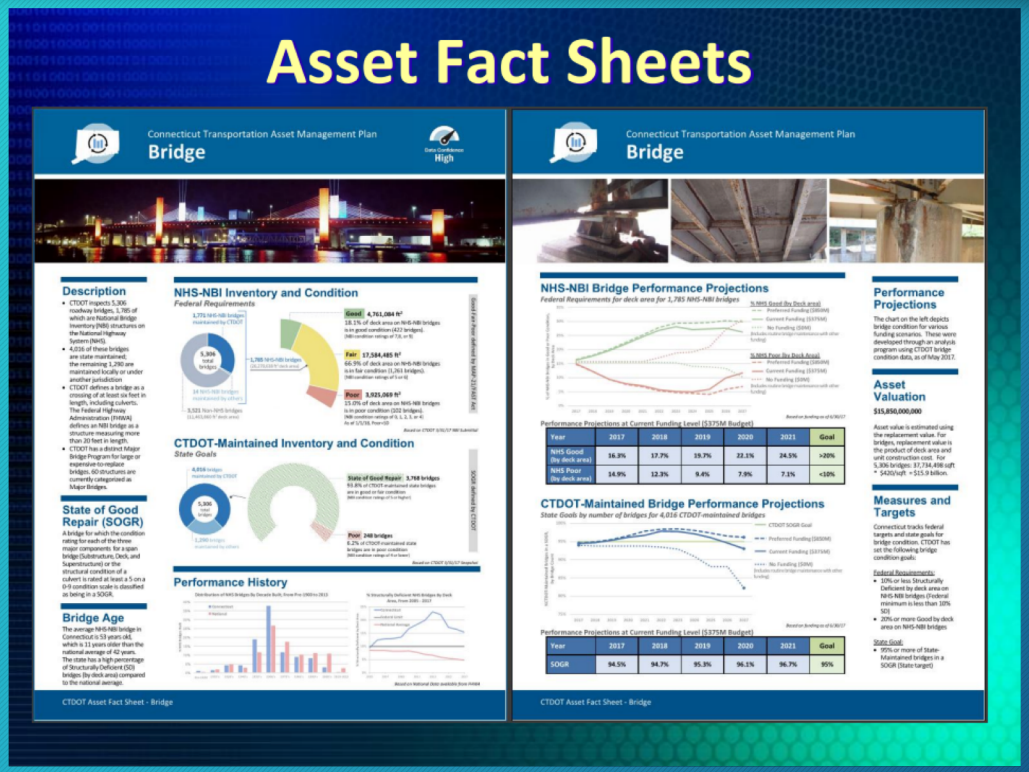
Technology Influences Decision-Making



Technology Influences Decision-Making

- Arizona showed how they have used probabilistic modeling to incorporate resilience into their design process.
- Iowa showed how they developed a tool to assist all Tier II transit operators in collecting the facility data needed to comply with the TAMP requirements, and how that data is now being used by agencies to help drive decisions.

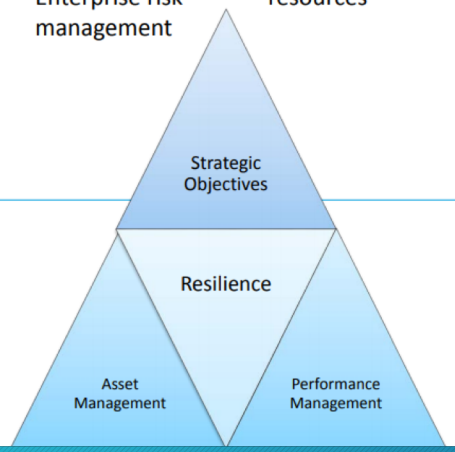
Data is Used to Tell the Story



Data is Used to Tell the Story

Integrating Resilience and Asset Management

Requirements/ Initiatives	Elements of Risk	Concepts and Tools	Practice
• Risk based asset management plans • Enterprise risk management	• Event • Damage • Available resources	• Risk • Vulnerability • Resilience • Risk registers • Risk scoring/ ranking	• Resilience measures not widely used or understood • Most risk analysis is qualitative • Poorly linked to decision making



Data is Used to Tell the Story

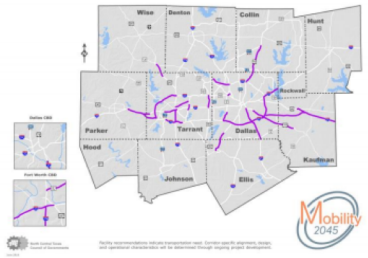
NCTCOG/TxDOT Asset Management Efforts

"Asset Optimization" – Corridor Data-Driven Solutions

12

- Corridor-level asset management & performance data integration
- Develop more holistic transportation planning & investment strategies using "**TransFACTS**"
- Targeting deficiencies & performance gaps efficiently to capitalize on functionality
- "**TransFACTS**" pilot study data applications:
  - Traffic Volume/Congestion
  - Crash Data
  - Geometric Issues/Facility Condition
  - TDM/TSM&O Applications
  - Access/Circulation Maximization
  - Socioeconomic & Environmental Justice Issues
  - Urban Design/Sustainability Initiatives

Asset Optimization Recommendations



Data is Used to Tell the Story

- Minnesota and Connecticut both showed examples of “one page” summaries of key assets to help tell the story to stakeholders.
- Research from the University of Delaware showed approaches to consider risk and resilience in our asset renewal decisions.
- A Texas MPO showed how they use data in corridor analysis to drive a comprehensive discussion with all stakeholders about bottlenecks.

Thanks!

- My track team: Steve Gaj, Matt Hardy, and John McCormick
- The virtual track and discussion session teams
- Our awesome moderators & recorders
- All of our speakers
- The conference sponsors, TRB staff, and the planning committee

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