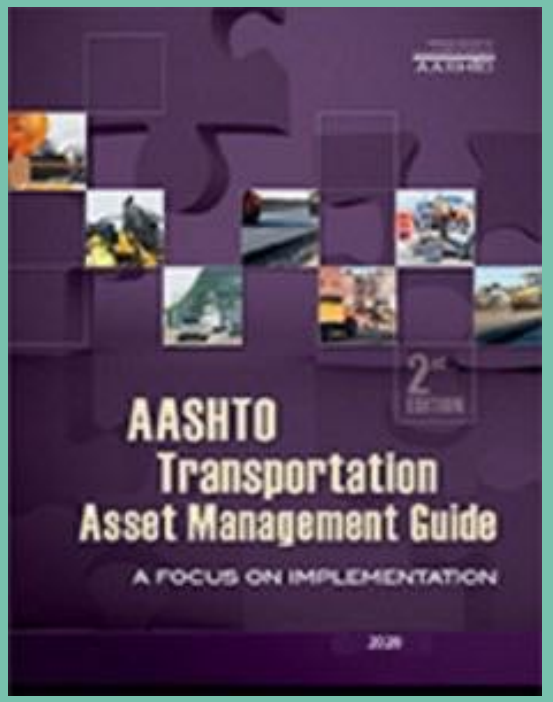
# AASHTO TAM Guide Book Club

**Webinar 7**

## Investment Strategies and Multi-Objective Decision Making

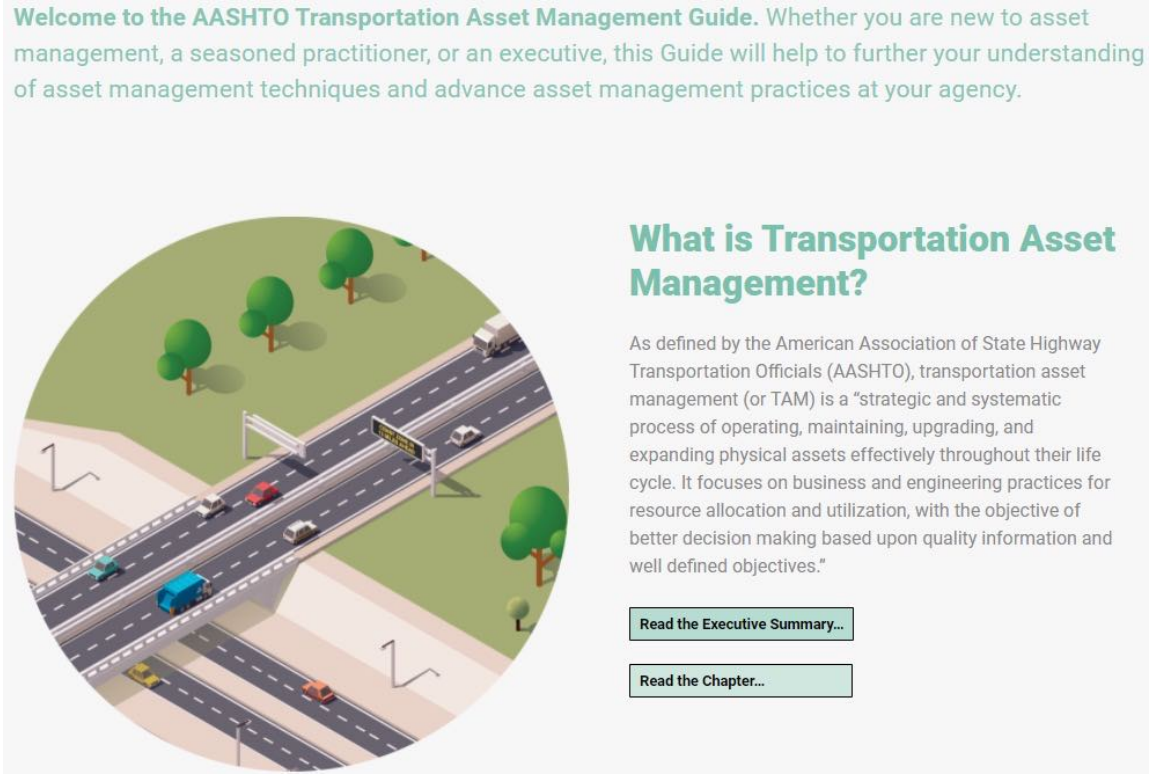
**For today's polls, visit menti.com and use the code 2865 8258**




**June 10, 2021**
**Sponsored by FHWA**

# AASHTO TAM Guide Book Club
## Welcome

- Welcome to the seventh installment of the book club
- The TAM Guide Book Club will be meeting again next week on **Wednesday 6/16**
  - Topic: Strengthening How Data Supports Your TAM Program
- Visit the AASHTO TAM Portal to register and for the complete archive of past webinars

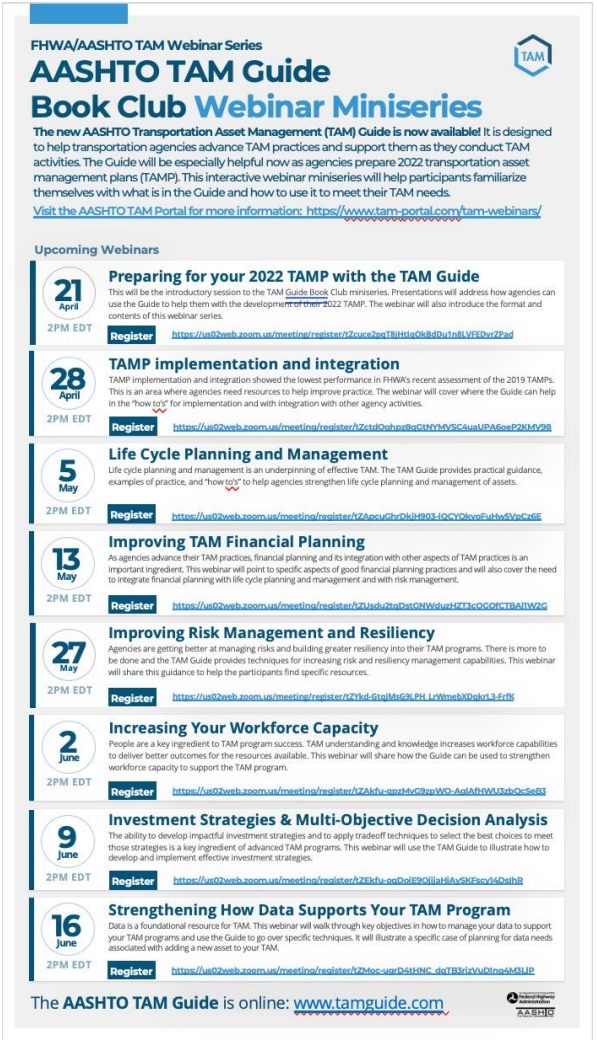



**https://www.tam-portal.com/event-directory/tam-webinars/**

# AASHTO TAM Guide Book Club
## Welcome

FHWA is pleased to sponsor this special TAM Guide Book Club Webinar series

- The AASHTO TAM Guide is a valuable resource for agencies starting to develop their next TAMP
- This series is designed to focus on the areas where agencies will derive the greatest benefit:
  - Eight sessions addressing TAMP Implementation, Life Cycle Planning and Management, Financial Planning, Risk and Resiliency, and more
- Today's topic is **Investment Strategies and Multi-Objective Decision Making**



FHWA/AASHTO TAM Webinar Series

AASHTO TAM Guide Book Club Webinar Miniseries

**The new AASHTO Transportation Asset Management (TAM) Guide is now available!** It is designed to help transportation agencies advance TAM practices and support them as they conduct TAM activities. The Guide will be especially helpful now as agencies prepare 2022 transportation asset management plans (TAMP). This interactive webinar miniseries will help participants familiarize themselves with what is in the Guide and how to use it to meet their TAM needs.

Visit the AASHTO TAM Portal for more information: https://www.tam-portal.com/tam-webinars/

Upcoming Webinars

**21 April, 2PM EDT** — Preparing for your 2022 TAMP with the TAM Guide
This will be the introductory session to the TAM Guide Book Club miniseries. Presentations will address how agencies can use the Guide to help them with the development of their 2022 TAMP. The webinar will also introduce the format and contents of this webinar series.
Register https://us02web.zoom.us/meeting/register/tZcuce2pqT8jHtIqOk8dDu1n8LVFEDvrZPad

**28 April, 2PM EDT** — TAMP implementation and integration
TAMP implementation and integration showed the lowest performance in FHWA's recent assessment of the 2019 TAMPs. This is an area where agencies need resources to help improve practice. The webinar will cover where the Guide can help in the "how to's" for implementation and with integration with other agency activities.
Register https://us02web.zoom.us/meeting/register/tZctdOqhpz8qGtNYMV5C4uaUPA6oeP2KMV9R

**5 May, 2PM EDT** — Life Cycle Planning and Management
Life cycle planning and management is an underpinning of effective TAM. The TAM Guide provides practical guidance, examples of practice, and "how to's" to help agencies strengthen life cycle planning and management of assets.
Register https://us02web.zoom.us/meeting/register/tZApcuGhrDkiH903-IOCYQkvoFuHw6VnCz6E

**13 May, 2PM EDT** — Improving TAM Financial Planning
As agencies advance their TAM practices, financial planning and its integration with other aspects of TAM practices is an important ingredient. This webinar will point to specific aspects of good financial planning practices and will also cover the need to integrate financial planning with life cycle planning and management and with risk management.
Register https://us02web.zoom.us/meeting/register/tZUsduGtqDstGNWduzHZT3cOGOfCTBAIIW2G

**27 May, 2PM EDT** — Improving Risk Management and Resiliency
Agencies are getting better at managing risks and building greater resiliency into their TAM programs. There is more to be done and the TAM Guide provides techniques for increasing risk and resiliency management capabilities. This webinar will share this guidance to help the participants find specific resources.
Register https://us02web.zoom.us/meeting/register/tZYkd-GtqjMsG9LPH_LrWmebXDgkr13-FrfK

**2 June, 2PM EDT** — Increasing Your Workforce Capacity
People are a key ingredient to TAM program success. TAM understanding and knowledge increases workforce capabilities to deliver better outcomes for the resources available. This webinar will share how the Guide can be used to strengthen workforce capacity to support the TAM program.
Register https://us02web.zoom.us/meeting/register/tZAkfu-qpzMvG9zpWO-AqlAfHWU3zbQc5eB3

**9 June, 2PM EDT** — Investment Strategies & Multi-Objective Decision Analysis
The ability to develop impactful investment strategies and to apply tradeoff techniques to select the best choices to meet those strategies is a key ingredient of advanced TAM programs. This webinar will use the TAM Guide to illustrate how to develop and implement effective investment strategies.
Register https://us02web.zoom.us/meeting/register/tZEkfu-qqDoiE9QiliaHiAvSKFscvI4DsIhB

**16 June, 2PM EDT** — Strengthening How Data Supports Your TAM Program
Data is a foundational resource for TAM. This webinar will walk through key objectives in how to manage your data to support your TAM programs and use the Guide to go over specific techniques. It will illustrate a specific case of planning for data needs associated with adding a new asset to your TAM.
Register https://us02web.zoom.us/meeting/register/tZMoc-uqrD4tHNC_daTB3rizVuDIng4M3LJP

The AASHTO TAM Guide is online: www.tamguide.com

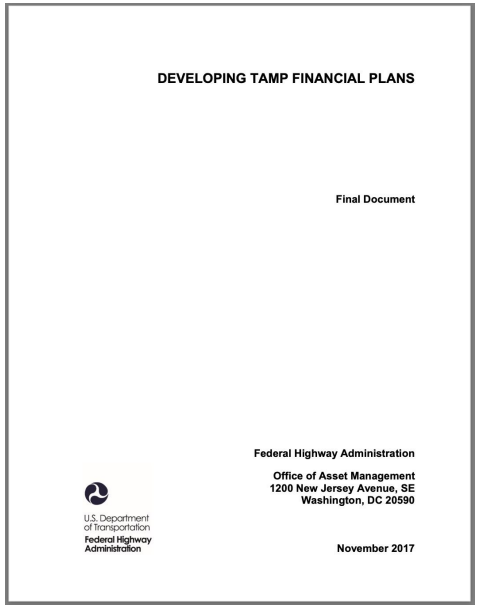
# AASHTO TAM Guide Book Club
## FHWA Resources

**Asset Management Financial Report Series (2015-2017)**
https://www.fhwa.dot.gov/asset/plans/financial/hif15018.pdf

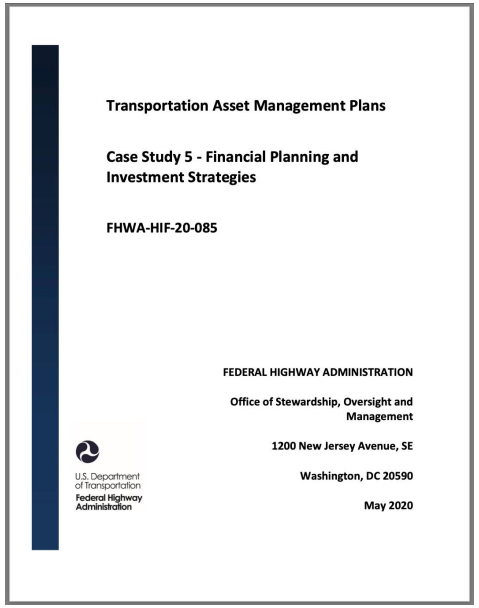
**Developing TAMP Financial Plans (2017)**
https://www.fhwa.dot.gov/asset/pubs/developing_tamp_fp.pdf

**Transportation Asset Management Plans: Case Study 5 – Financial Planning and Investment Strategies (2020)**
https://www.fhwa.dot.gov/asset/pubs/hif20085_case5.pdf


2015




2017




2020

# AASHTO TAM Guide Book Club
## Agenda

| | |
|---|---|
| **2:00 PM** | **Introduction**<br>Steve Gaj, FHWA |
| **2:05 PM** | **Agenda and Topic Introduction**<br>Bill Robert, Spy Pond Partners |
| **2:10 PM** | **Use Case Scenarios**<br>Lina Chapman and Michael Case, Michigan DOT<br>Randy Goodman, Louisiana DOTD<br>Steve Wilcox and Michael Rossi, New York State DOT<br>Mike Johnson, Caltrans |
| **2:50 PM** | **Guidance Quests – Breakout Sessions** |
| **3:15 PM** | **Breakout Session Feedback** |
| **3:20 PM** | **Open Discussion and Q&A** |

# What Is a TAM Investment Strategy?

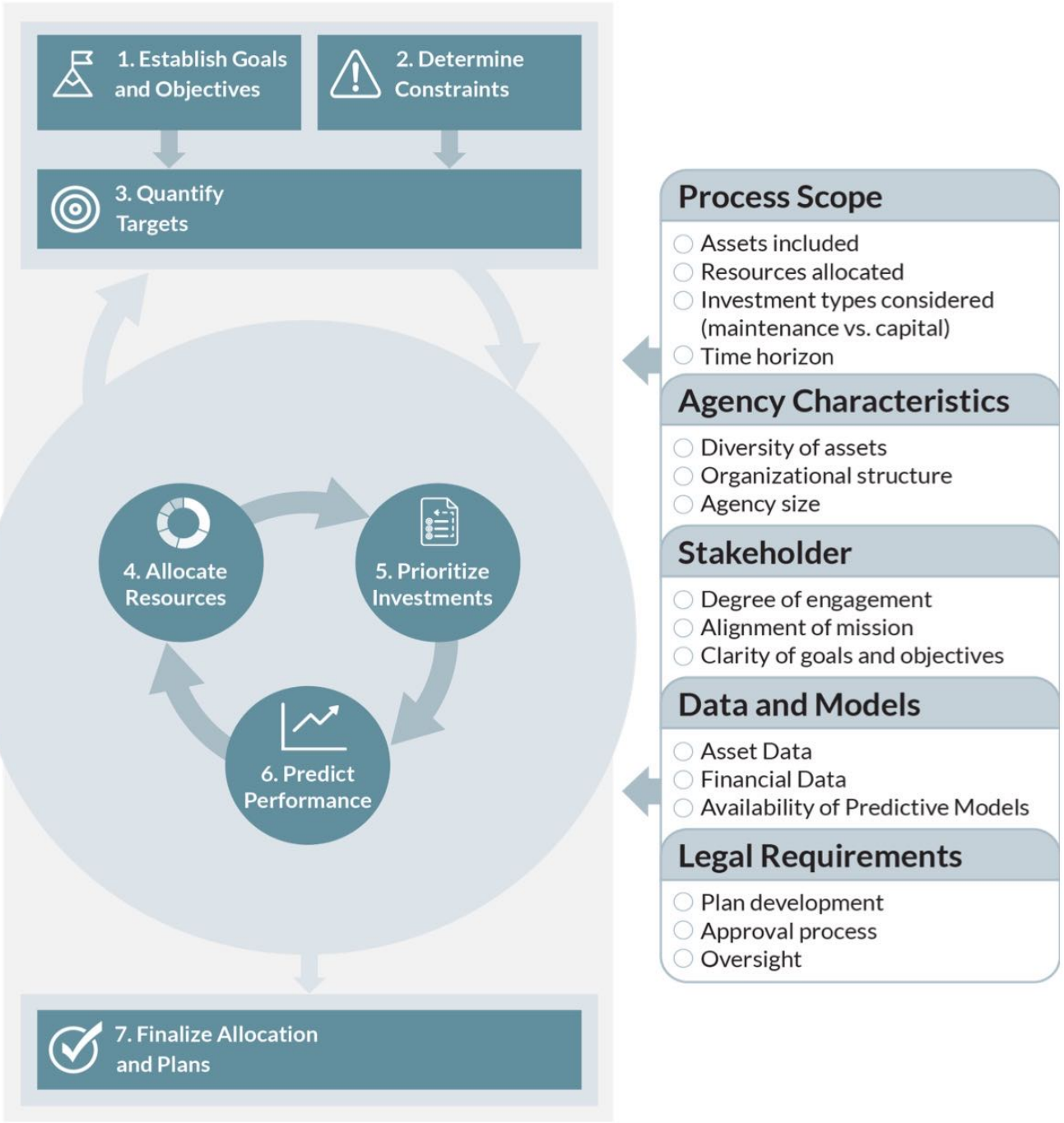
*Investment strategy* means a set of strategies that result from evaluating various levels of funding to achieve State DOT targets for asset condition and system performance effectiveness at a minimum practicable cost while managing risks.

23 CFR 515.5

# Approaches for Describing Investment Strategy

- Presentation of different investment scenarios with different budget allocations or changes to other variables
- Narrative description detailing how investment decisions are made
- Description of areas of emphasis given available funding, the desired state of good repair, etc…
- Or other approaches…

# Resource Allocation Process



# Relationship of Resource Allocation and Investment Strategies

- Resource allocation process and process of developing investment strategies are essentially equivalent
- However, the TAM Guide doesn't specifically address how to meet the FHWA TAMP requirements
- Different approaches are presented for improving cross asset resource allocation/investment strategy development
  - Use of Performance Targets
  - Use of Multiple-Objective Decision Analysis (MODA)

How-to

# Implementing a Multi-Objective Decision Analysis (MODA) Approach

**This checklist provides a list of the steps involved in implementing a MODA approach.** Agencies can use this checklist to determine if they have considered all the necessary steps in setting up their approach for prioritizing projects or investments. Note that this checklist is a summary of the materials presented in the final report of NCHRP Project 08-103. This report has additional details on each of the elements described here.

## 1. Establish the Scope

- **Determine which assets to include.** Specify the asset classes to consider as part of the analysis. Often a cross-asset resource allocation approach will focus initially on pavements and bridges, but may extend to other asset classes as well, such as drainage assets, traffic and safety assets, and facilities.
- **Determine which investments to include.** A cross-resource allocation decision-making process should include investments in existing assets, such as preservation, rehabilitation and replacement or reconstruction actions. The process may include other types of investments, such as improvements in safety or mobility, as well.
- **Determine the investment period.** It is also important to determine the time frame for investments being considered. Often the process is defined to prioritize investments over a single one or two-year decision period, but it may be defined to include investments over multiple periods.
- **Decide how the approach relates to the existing business process.** Every organization has some sort of process for making decisions about it investments in its assets. In this step one must consider the existing process and how an improved cross-asset resource allocation process will be integrated into it. For instance, the process might entail replacing one or more steps in the existing process with a more formal approach to identifying investment needs and prioritizing potential investments.
- **Decide how the results will be used.** One must decide how the results of the process are intended to be used. Will they help establish the level of investments in different assets or types of investments? Or provide an initial set of priorities for decision-makers to review? Or help document the final selection of specific candidate investments through a formalized process?

**MODA Implementation**

1. Establish the Scope
2. Define Goals and Objectives
3. Select Performance Measures and Evaluation Criteria
4. Assess Data and Analytical Capabilities
5. Prototype the Approach
6. Set Weights on Goals and Objectives
7. Apply the Model
8. Communicate the Results

# AASHTO TAM Guide Book Club
## Today's Speakers

- **Lina Chapman and Michael Case**
  - Michigan DOT
- **Randy Goodman**
  - Louisiana DOTD
- **Steve Wilcox and Michael Rossi**
  - New York State DOT
- **Mike Johnson**
  - Caltrans

# TAMP Investment Strategies and PIT

MDOT

BTP Bureau of Transportation Planning

## AASHTO TAM Guide Book Club #7

June 10, 2021

**Michael Case** – Investment Strategies

**Lina Chapman** – Project Identification Tool (PIT)

# TAMP Investment Strategies and PIT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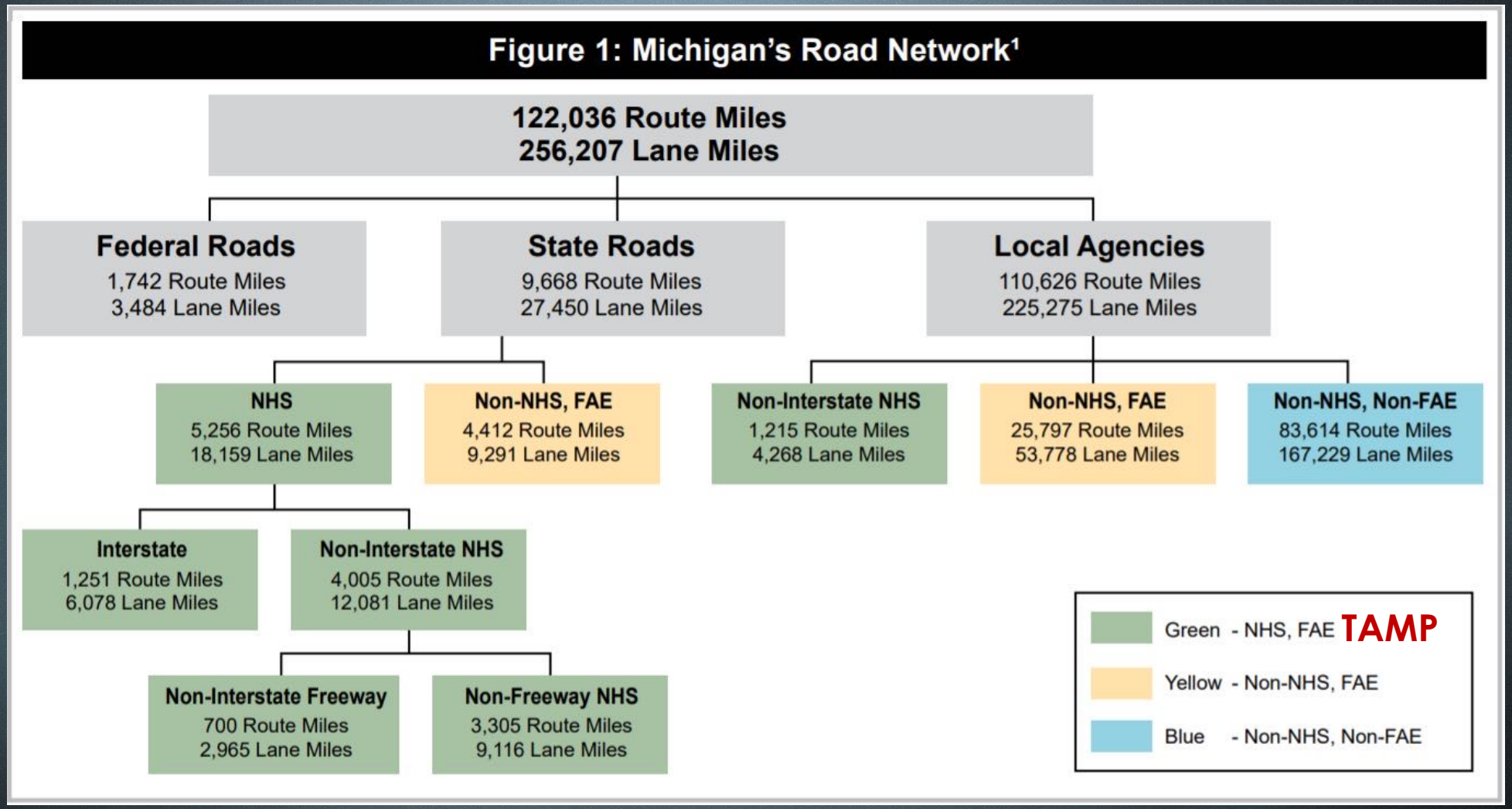
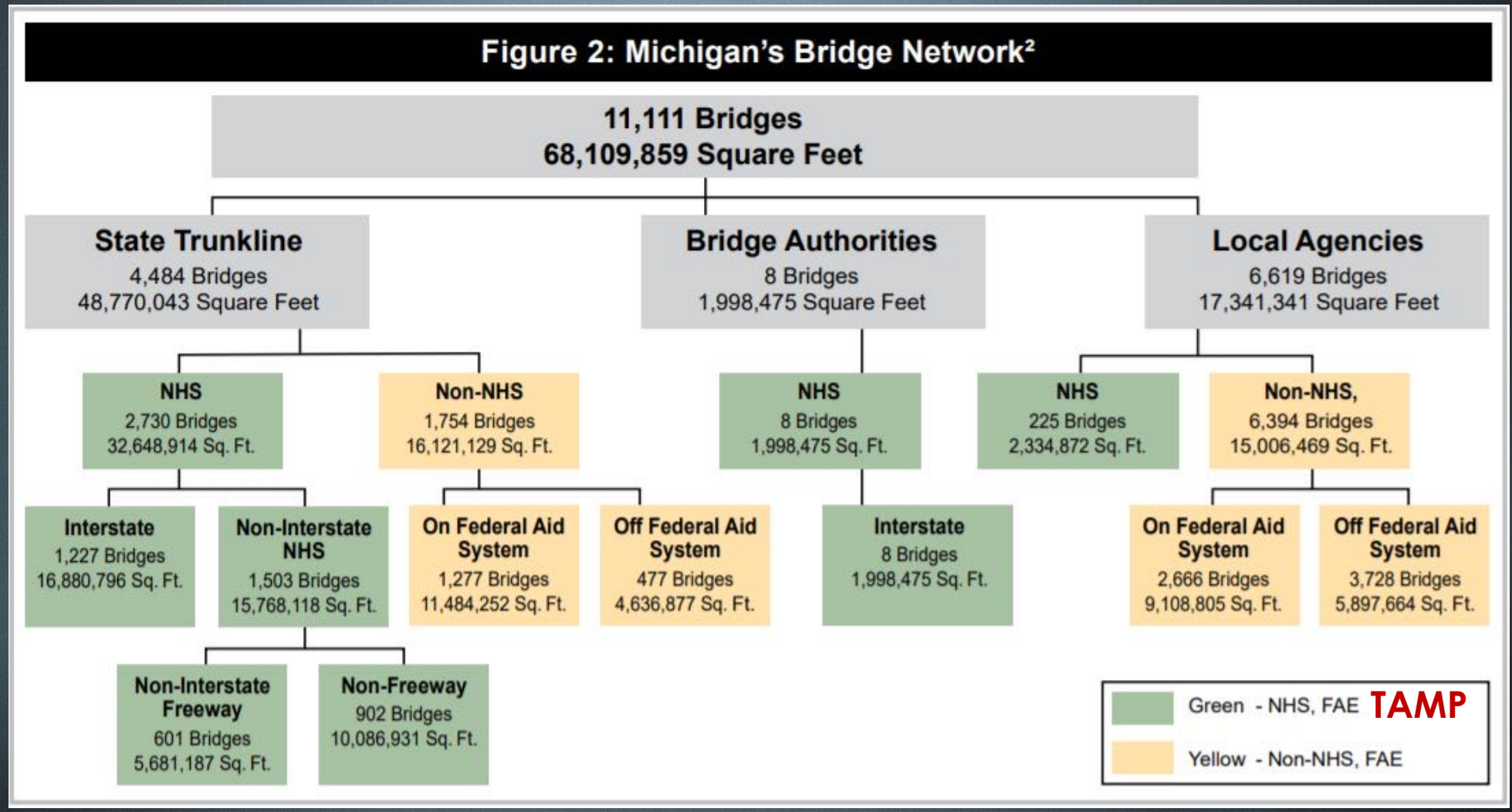
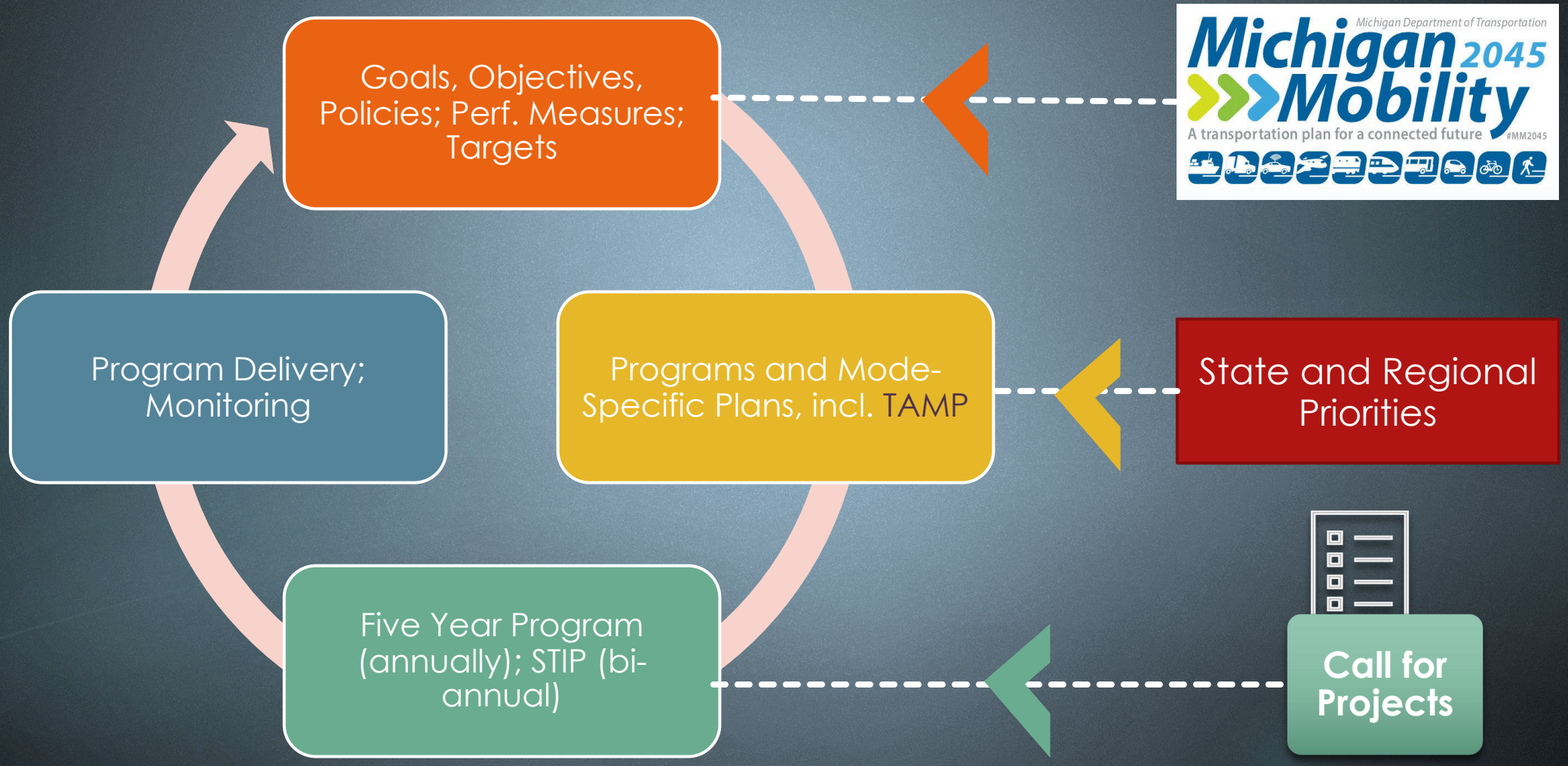
# TAMP Investment Strategies and PIT



# TAMP Investment Strategies and PIT



# TAMP Investment Strategies and PIT



# TAMP Investment Strategies and PIT

## MDOT TAMP Overview

# TAMP Investment Strategies and PIT

Michigan Transportation Asset Management Council

Created by the State Legislature (HB 5396/P.A. 499 of 2002, Act 199 of 2007) "All public roads in Michigan will be managed using the principles of asset management."

- 11 Person Asset Management Council
- PA 499 explicitly terms asset management a "strategic process" in which:
  - Goals and objectives are set,
  - life-cycle costs are analyzed, and
  - Investment strategies are recommended.
- Requires a joint multi-year road and bridge program

- In addition:
  - Michigan law requires life-cycle cost analysis for any project where the "pavement" costs exceed $1 million (MDOT only), and
  - State law allows for additional flexibility in the use of state funds if a community has an asset management program in place.

# MDOT TAMP Investment Strategies

# TAMP Investment Strategies and PIT

# TAMP Investment Strategies and PIT

Michigan Department of Transportation

**Figure 46: MDOT State of Good Repair (SOGR) Goals**

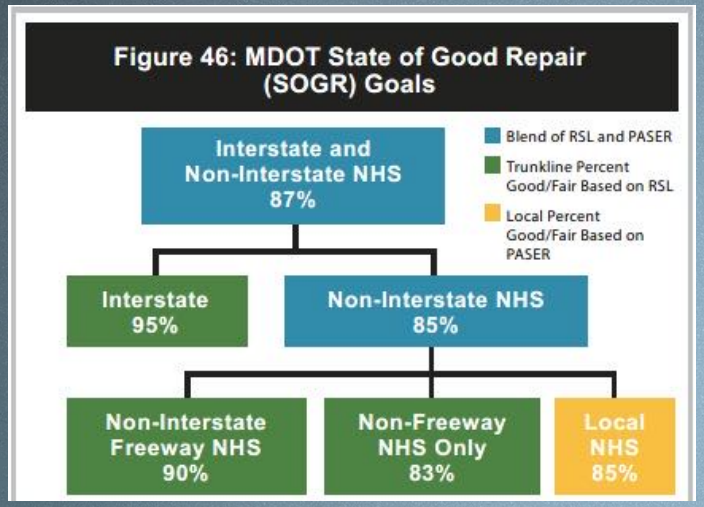



**Figure 48: Projected MDOT Interstate RSL Pavement Condition**

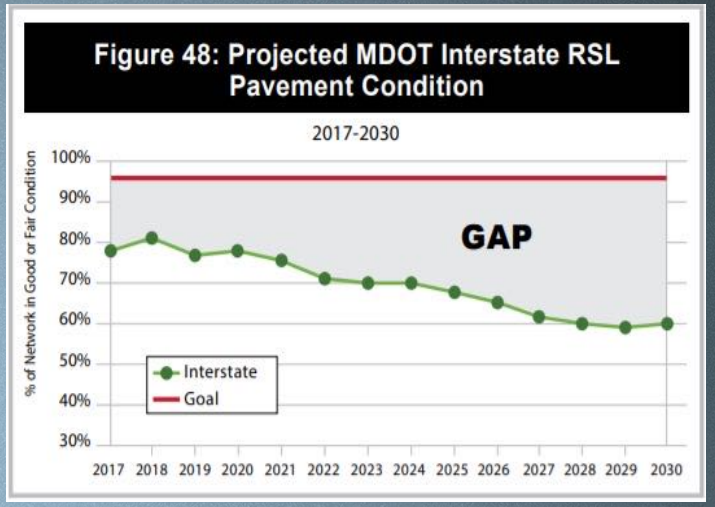



**Figure 49: Projected MDOT Non-Interstate RSL and PASER Condition**

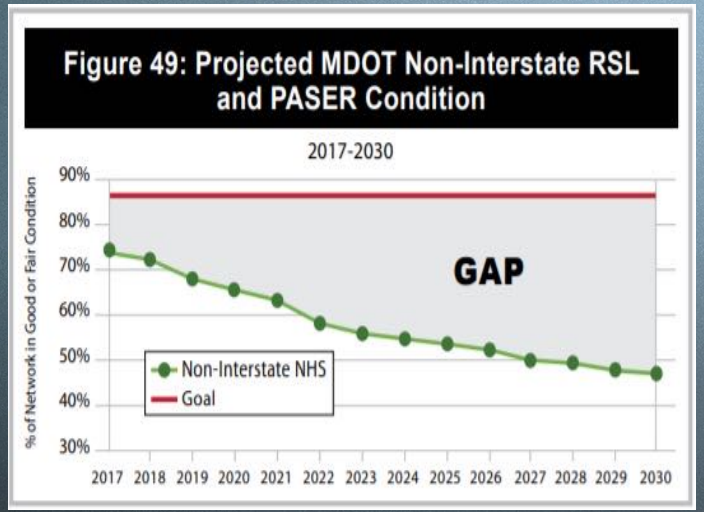
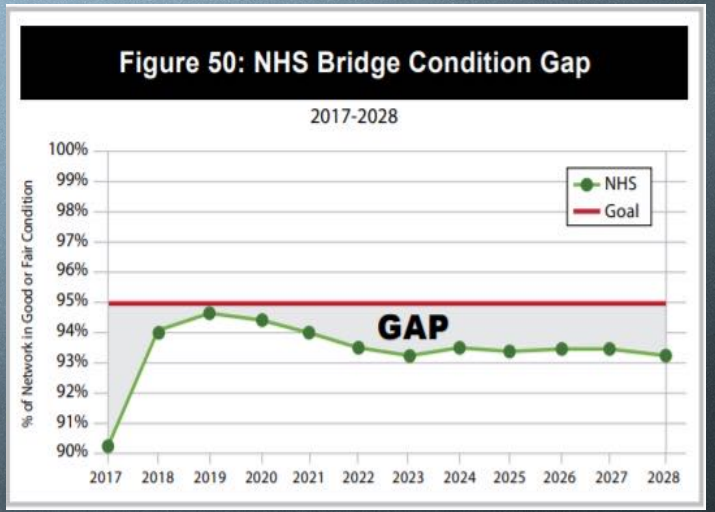



**Figure 50: NHS Bridge Condition Gap**

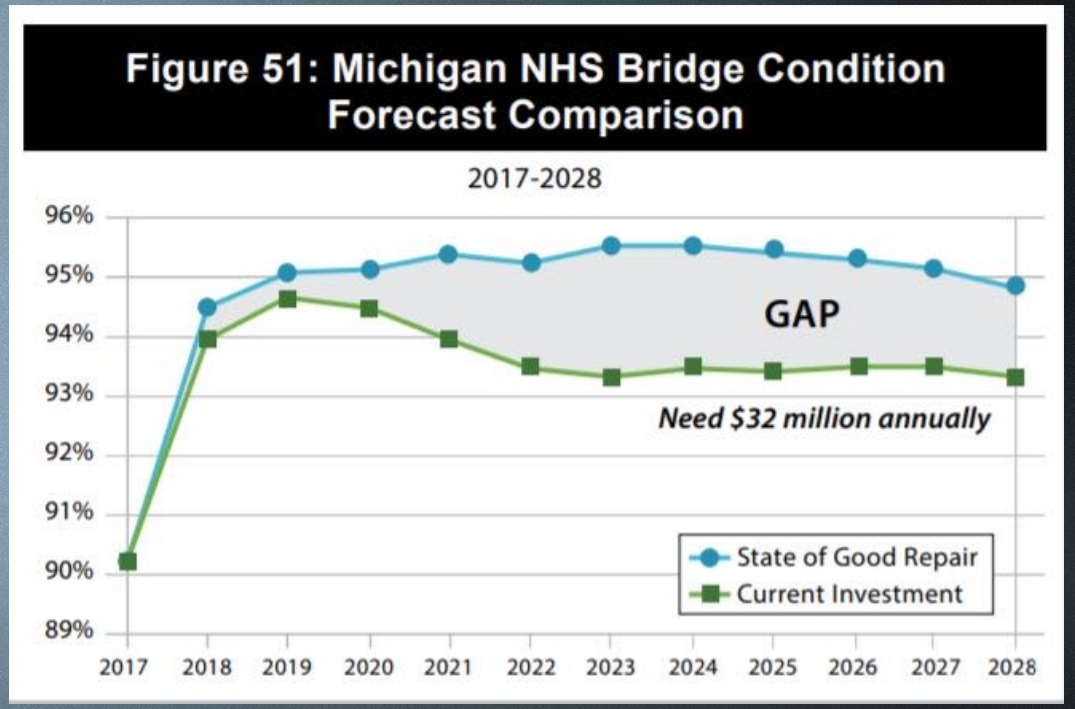


# TAMP Investment Strategies and PIT

Michigan Department of Transportation

**Figure 37: State of Good Repair (SOGR) NHS Bridge Investment Strategy** *(in millions)*

| | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 10-Year Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Revenue for NHS** | | | | | | | | | | | |
| Revenue Available for NHS Trunkline Capital Program | $1,059 | $1,018 | $1,166 | $1,204 | $1,214 | $1,229 | $1,244 | $1,262 | $1,286 | $1,434 | $12,117 |
| Maintenance (Pavement and Bridge) | $349 | $351 | $353 | $354 | $361 | $367 | $374 | $381 | $388 | $395 | $3,674 |
| **Expected Cost of Future Work - Constrained Target** | | | | | | | | | | | |
| Trunkline Bridge | $142 | $169 | $120 | $93 | $103 | $99 | $112 | $112 | $112 | $112 | $1,174 |
| Bridge Authorities and Local Agencies | $27 | $32 | $23 | $27 | $40 | $56 | $74 | $24 | $26 | $25 | $354 |
| Total | $169 | $201 | $143 | $120 | $143 | $155 | $186 | $136 | $138 | $137 | $1,528 |
| **Bridge - Constrained - Expected Work Needed** | | | | | | | | | | | |
| Reconstruction | $89 | $103 | $78 | $64 | $69 | $67 | $66 | $66 | $66 | $66 | $735 |
| Rehabilitation | $47 | $54 | $41 | $34 | $36 | $35 | $43 | $43 | $43 | $43 | $420 |
| Preservation | $39 | $45 | $34 | $28 | $30 | $29 | $35 | $35 | $35 | $35 | $343 |
| Bridge Authorities and Local Agencies | $27 | $32 | $23 | $27 | $40 | $56 | $74 | $24 | $26 | $25 | $354 |
| Total | $201 | $233 | $175 | $152 | $175 | $187 | $218 | $168 | $170 | $169 | $1,851 |
| | | | | | | | | | | | |
| **NHS Bridge Revenue Gap - State of Good Repair** | **$32** | **$32** | **$32** | **$32** | **$32** | **$32** | **$32** | **$32** | **$32** | **$32** | **$323** |




Additional $32M/year needed to achieve 95% good/fair deck area

# TAMP Investment Strategies and PIT

Michigan Department of Transportation

**Figure 35: Constrained NHS Pavement Investment Strategy - Based on RSL Performance Measure** *(in millions)*

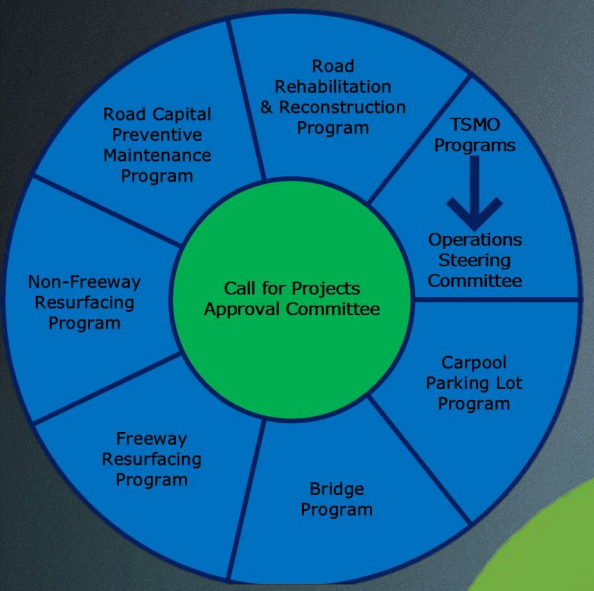
| | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 10-Year Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Revenue for NHS** | | | | | | | | | | | |
| Revenue Available for NHS Trunkline Capital Program | $1,059 | $1,018 | $1,166 | $1,204 | $1,214 | $1,229 | $1,244 | $1,262 | $1,286 | $1,434 | $12,117 |
| Maintenance (Pavement and Bridge) | $349 | $351 | $353 | $354 | $361 | $367 | $374 | $381 | $388 | $395 | $3,674 |
| **Expected Cost of Future Work - Constrained Target** | | | | | | | | | | | |
| NHS Pavement (Trunkline and Local) | $544 | $677 | $758 | $770 | $778 | $770 | $770 | $773 | $773 | $776 | $7,389 |
| **Pavement - Constrained Investment - Expected Work Needed** | | | | | | | | | | | |
| Reconstruction | $207 | $267 | $516 | $410 | $351 | $448 | $398 | $400 | $400 | $412 | $3,809 |
| Rehabilitation | $238 | $248 | $185 | $280 | $342 | $251 | $296 | $297 | $297 | $289 | $2,724 |
| Preservation | $99 | $162 | $57 | $80 | $85 | $70 | $75 | $76 | $76 | $76 | $857 |
| Initial construction | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Total | $544 | $677 | $758 | $770 | $778 | $770 | $770 | $773 | $773 | $776 | $7,389 |
| | | | | | | | | | | | |
| **Constrained Investment - NHS Pavement Revenue Gap** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** |

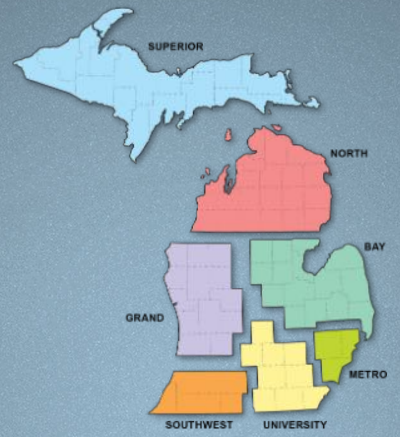
Selected Investment Strategy - Constrained

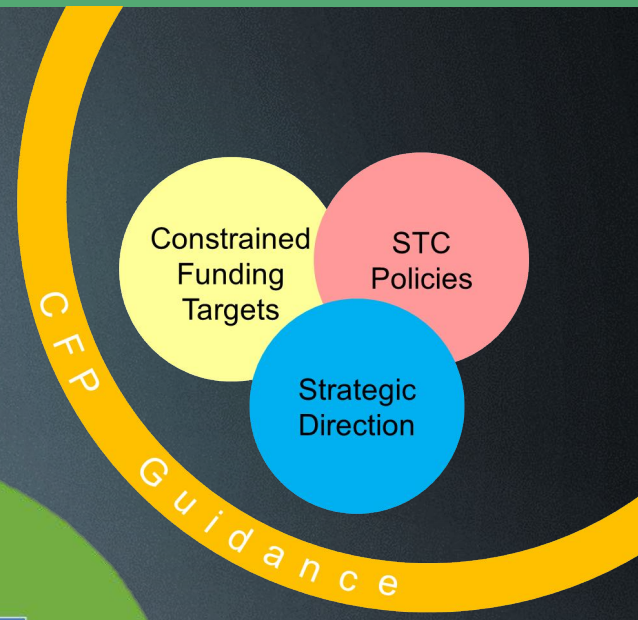
# TAMP Investment Strategies and PIT

MDOT Michigan Department of Transportation

BTP



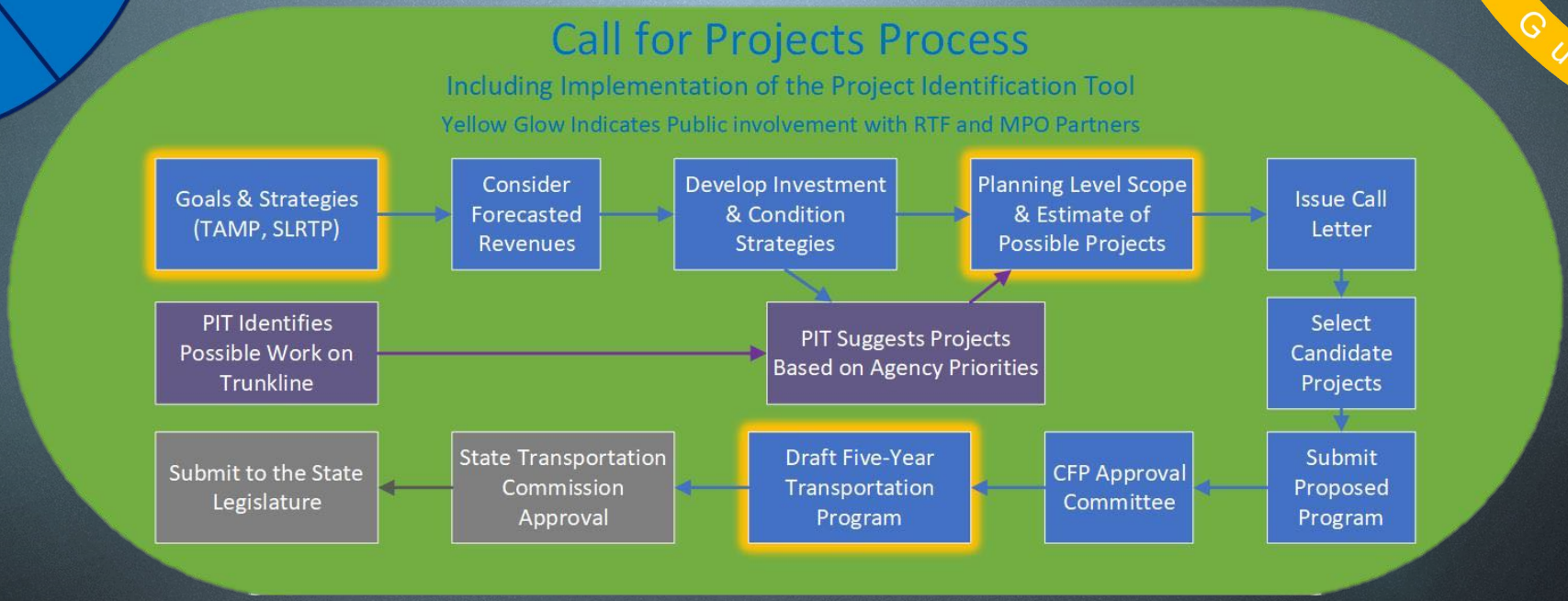



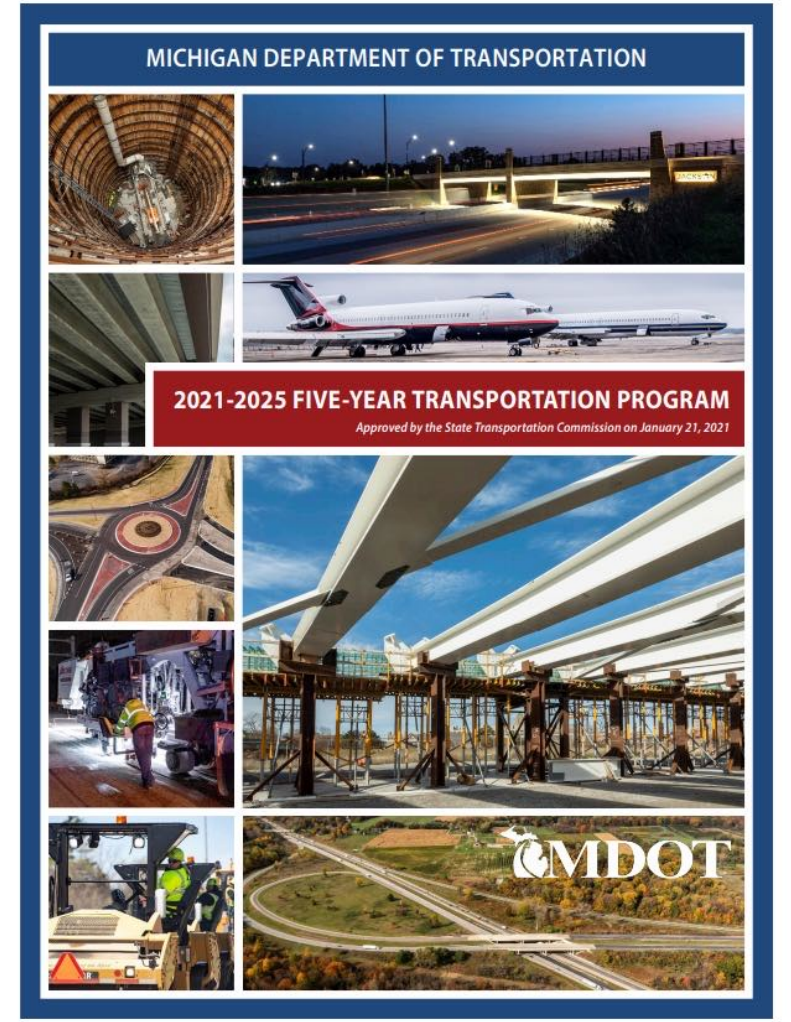

## Call for Projects Process

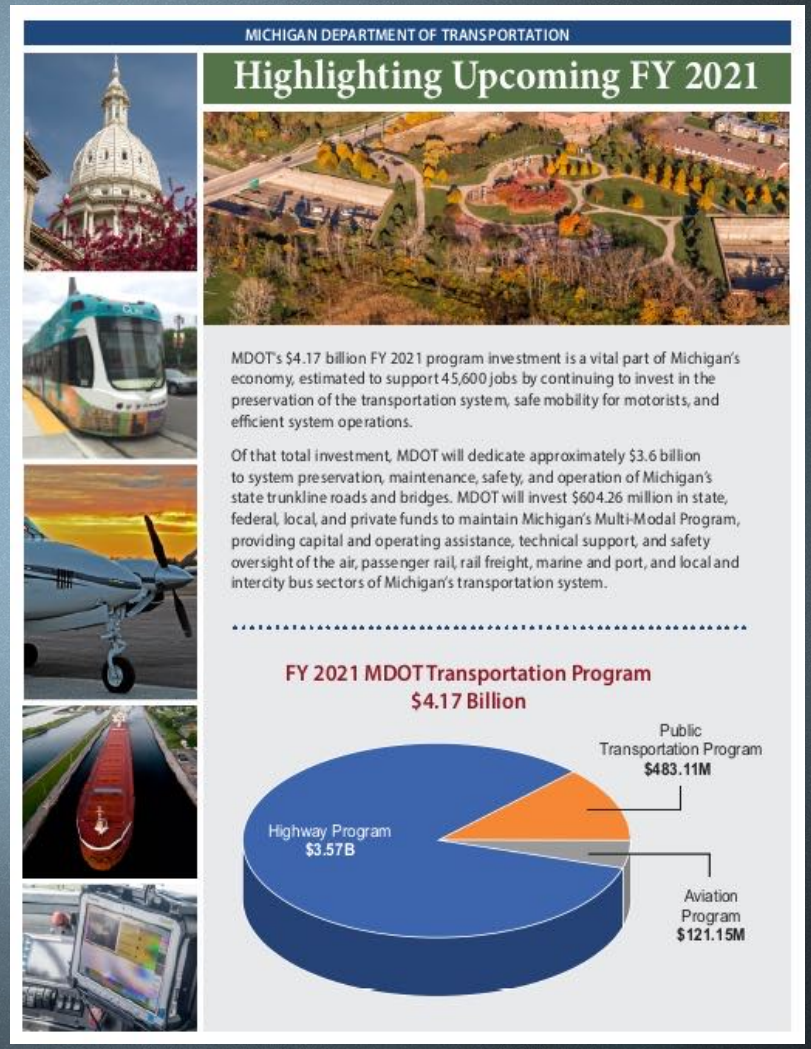
Including Implementation of the Project Identification Tool

Yellow Glow Indicates Public involvement with RTF and MPO Partners



# TAMP Investment Strategies and PIT



# TAMP Investment Strategies and PIT

## Project Identification Tool (PIT)

# TAMP Investment Strategies and PIT

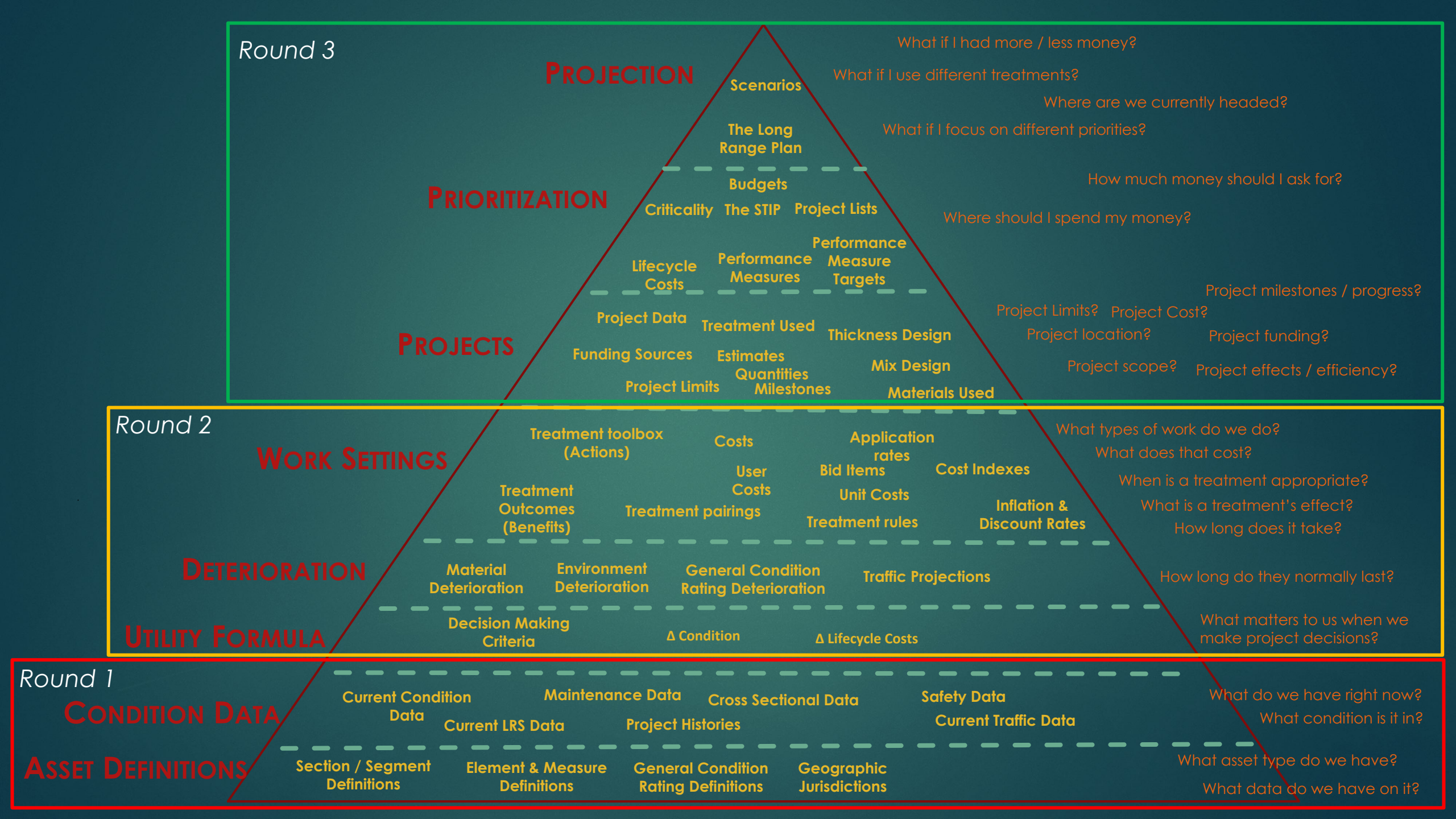
## PIT - Business Need for the Project

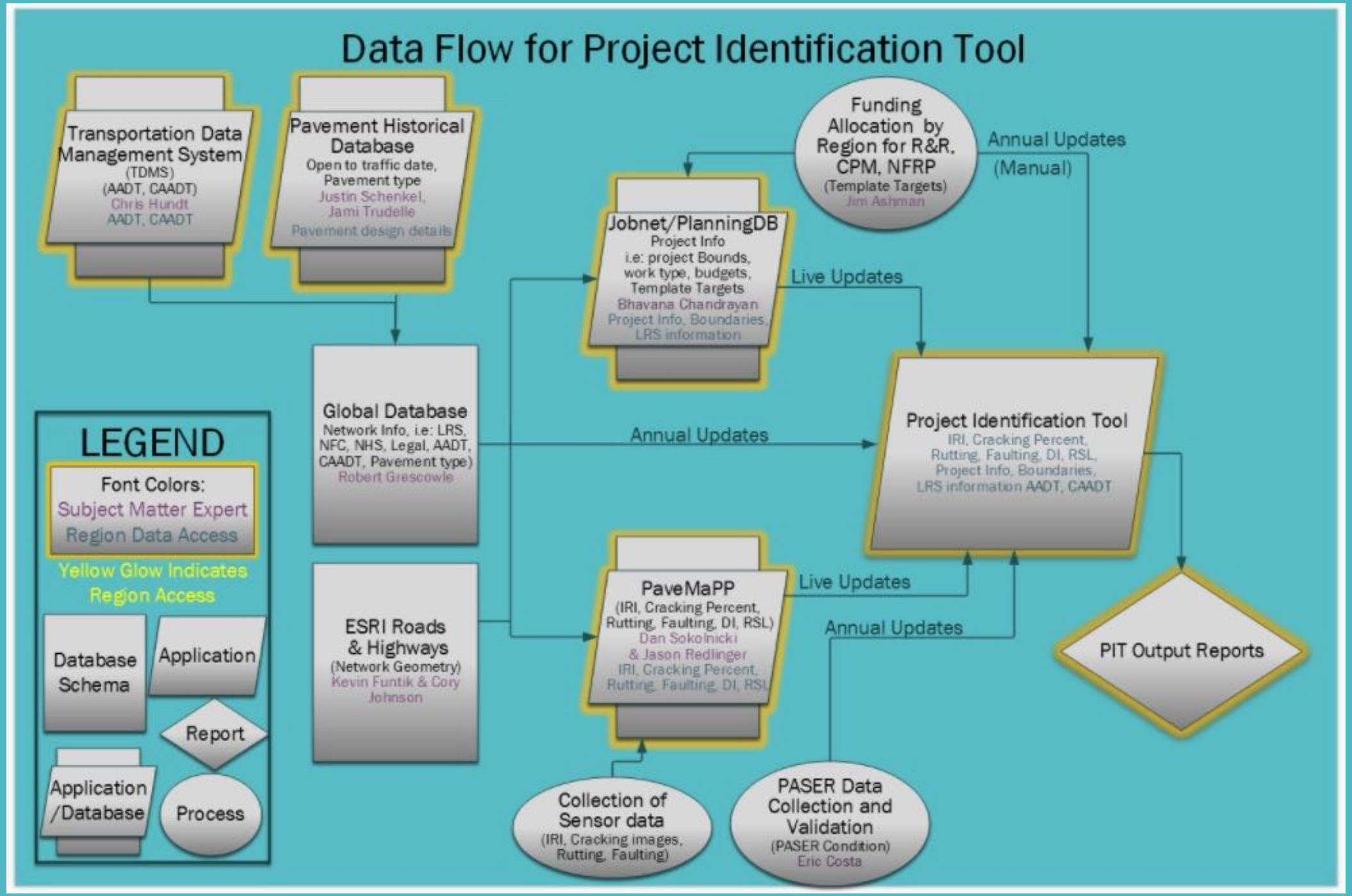
- Core responsibility of the department is to maintain pavement assets
- Highway Capital Program Call for Projects process drives the 5-Year Transportation Program investment strategy
- Assist MDOT Region System Managers in:
  - Identifying candidate pavement sections
  - Identifying best fix for those sections and recommend projects
  - Ranking those projects based on cost/benefit
- Assist MDOT Central Office staff in:
  - Forecasting pavement conditions and running scenarios based on RSL, PCM

# TAMP Investment Strategies and PIT

## Objectives of the PIT

| | |
|---|---|
| Identify | Identify candidate pavement projects. |
| Prioritize | Prioritize projects based on cost/benefit analysis. |
| Optimize | Optimize projects based on set goals and available funding. |
| Forecast | Forecast condition based on state Remaining Service Life (RSL) and federal metrics: International Roughness Index (IRI), Fault/Rut, Cracking %. |
| Utilize | Utilize results to support CFP selection process, 5YTP development, and implement SLRTP and TAMP goals and objectives as set by STC and FHWA. |


Round 3
PROJECTION
Scenarios
The Long Range Plan
What if I had more / less money?
What if I use different treatments?
Where are we currently headed?
What if I focus on different priorities?
PRIORITIZATION
Budgets
Criticality
The STIP
Project Lists
How much money should I ask for?
Where should I spend my money?
Lifecycle Costs
Performance Measures
Performance Measure Targets
PROJECTS
Project Data
Treatment Used
Thickness Design
Funding Sources
Estimates
Quantities
Mix Design
Project Limits
Milestones
Materials Used
Project milestones / progress?
Project Limits?
Project Cost?
Project location?
Project funding?
Project scope?
Project effects / efficiency?
Round 2
WORK SETTINGS
Treatment toolbox (Actions)
Costs
Application rates
User Costs
Bid Items
Cost Indexes
Treatment Outcomes (Benefits)
Unit Costs
Treatment pairings
Treatment rules
Inflation & Discount Rates
What types of work do we do?
What does that cost?
When is a treatment appropriate?
What is a treatment's effect?
How long does it take?
DETERIORATION
Material Deterioration
Environment Deterioration
General Condition Rating Deterioration
Traffic Projections
How long do they normally last?
UTILITY FORMULA
Decision Making Criteria
Δ Condition
Δ Lifecycle Costs
What matters to us when we make project decisions?
Round 1
CONDITION DATA
Current Condition Data
Maintenance Data
Cross Sectional Data
Safety Data
Current LRS Data
Project Histories
Current Traffic Data
What do we have right now?
What condition is it in?
ASSET DEFINITIONS
Section / Segment Definitions
Element & Measure Definitions
General Condition Rating Definitions
Geographic Jurisdictions
What asset type do we have?
What data do we have on it?


Data Flow for Project Identification Tool
Transportation Data Management System
(TDMS)
(AADT, CAADT)
Chris Hundt
AADT, CAADT
Pavement Historical Database
Open to traffic date, Pavement type
Justin Schenkel, Jami Trudelle
Pavement design details
Funding Allocation by Region for R&R, CPM, NFRP
(Template Targets)
Jim Ashman
Annual Updates
(Manual)
Jobnet/PlanningDB
Project Info
i.e: project Bounds, work type, budgets, Template Targets
Bhavana Chandrayan
Project Info, Boundaries, LRS information
Live Updates
Global Database
Network Info, i.e: LRS, NFC, NHS, Legal, AADT, CAADT, Pavement type)
Robert Grescowle
Annual Updates
Project Identification Tool
IRI, Cracking Percent, Rutting, Faulting, DI, RSL, Project Info, Boundaries, LRS information AADT, CAADT
LEGEND
Font Colors:
Subject Matter Expert
Region Data Access
Yellow Glow Indicates Region Access
Database Schema
Application
Report
Application /Database
Process
ESRI Roads & Highways
(Network Geometry)
Kevin Funtik & Cory Johnson
PaveMaPP
(IRI, Cracking Percent, Rutting, Faulting, DI, RSL)
Dan Sokolnicki & Jason Redlinger
IRI, Cracking Percent, Rutting, Faulting, DI, RSL
Live Updates
Annual Updates
PIT Output Reports
Collection of Sensor data
(IRI, Cracking images, Rutting, Faulting)
PASER Data Collection and Validation
(PASER Condition)
Eric Costa

# TAMP Investment Strategies and PIT

## PIT Phase II Considerations

- Integration with BrM (Bridge Management) to perform multi-asset analysis
- Incorporate/modernize in-house Road Quality Forecasting System (RQFS) tool used to generate statewide network level forecasts in one app
- Lifecycle cost analysis at the section level to compare the benefits of different actions

# TAMP Investment Strategies and PIT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# Thank You

TAMC:
www.Michigan.gov/TAMC/

TAMP:
www.Michigan.gov/AssetManagement

5YTP:
www.Michigan.gov/MDOT5YearProgram

# LADOTD
# Investment Strategies & Cross-Asset Resource Allocation Process

**2021 TAM Book Club Session 7 Webinar**

Louisiana Department of Transportation & Development

Randy Goodman, P.E.
Asset Management Engineer
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June 10, 2021

DOTD
LOUISIANA DEPARTMENT OF TRANSPORTATION & DEVELOPMENT

# LADOTD's Resource Allocation Process (Ref. AASHTO TAM Guide Ch. 5)

- LADOTD's Resource Allocation approach
  - Louisiana has implemented a cross-asset resource allocation approach based on performance targets, and does not currently consider the MODA (Multi-Objective Decision Analysis) approach.
  - Cross-asset resource allocation allows for setting performance targets and then prioritizing specific investments to achieve those targets.
  - Key Point: Louisiana has 3,045 NHS bridges with 129,528,374 square feet of deck area. That is currently the 4th highest total deck area in the nation, just slightly behind Florida.

# Investment Strategy Requirements

- Per 23 CFR 515.7(e) agencies have to devise investment strategies that meet the requirements of 23 CFR 515.9(f), which emphasizes maintaining the DSGR over the life cycle of the assets. 515.9(f) also focuses on preserving asset condition, meeting targets and meeting national goals.

- Per 23 CFR 515.7 Investment Strategies need to consider:
  - Performance Gaps
  - LCP (life cycle planning),
  - Risk management analysis,
  - Funding & work type costing for various candidate strategies.

# Investment Strategy Concepts

- FHWA in MAP21 defines an investment approach as “a set of strategies that result from evaluating various levels of funding to achieve state DOT targets for asset condition and system performance effectiveness at a minimum practicable cost while managing risk”.

- Investment strategies begin with a thorough understanding of projected funding and with estimates of the preservation and renewal activities that can be accomplished within funding constraints. The development of various investment strategies for an organization is an iterative process that is best served using the predictive capabilities of the pavement (PMS),and bridge management systems (BMS). The outcome of investment strategies will lead to identifying if performance targets will be met.

# Investment Strategy Concepts (cont)

- Comprehensive investment strategies are directly influenced by life cycle planning, gap analysis and risk analysis. The strategies also consider changes in factors such as growth trends, technology, design and construction.

- In the 2019 NCHRP Research Report 898, “A Guide to Developing Financial Plans and Performance Measures for Transportation Asset Management”, we find excellent guidance on how to finalize a financial plan and its investment strategies in Chapter 5, “Investment Strategies and Scenarios”.

- Federal Funding Match Shortfalls can occur in Louisiana due to insufficient 1980’s era TTF funding. A funding shortfall could cause a possible penalty assessment based on failure to achieve the DSGR or failure to achieve the performance targets.

# Overall Investment Strategies

- LADOTD's Office of Planning projects Annual Highway Budget Partitions out for 10 years to provide the projected funding for investment strategies. These serve as the agency's tactical plans represented by the annual Highway Priority Program.

- LADOTD incorporates several overall strategies, including life cycle planning strategies, into its process when allocating funding for pavements and bridges including:
  - Preservation funding focusing on minimizing the "worst first" strategy. "Worst first" strategies cannot be totally eliminated as some assets simply cannot be removed from the system (Example: high volume NHS routes).
  - Interstate and Non-Interstate NHS pavements now have their own funding categories to better manage asset condition and aid in addressing performance gaps.

# Overall Investment Strategies (cont)

- Capacity funding will be relegated to non-traditional means such as Grant Anticipation Revenue Vehicles (GARVEE) bonds, etc.
- Perform risk management assessments, including 23 CFR Part 667 repeat damage from emergency event evaluations for asset classes.
- Maximize the life cycle performance of asset classes, via cross-asset resource allocation analysis, on a priority basis with the goals of achieving the DSGR for asset classes and addressing performance gaps.
- Perform iterative PMS and BMS analysis using various budget scenarios on the different asset sub-groups to identify the most compelling funding for each asset class using actual treatments (work types in 23 CFR 515.7(b)).

# Overall Investment Strategies (cont)

- Select the most opportune “cross-asset resource allocation” budget for each asset class based on various priorities:
  - Allocate funding to various bridge asset classes in the following order, NHS bridges, SHS bridges, RHS bridges.
  - Allocate funding to various pavement asset classes in the following order: Interstates, Non-Interstate NHS, SHS & RHS.
  - On all assets, bridges take the priority over pavements for funding when funding constraints are encountered. The concept here is that gravel roads can be used, but closed bridges become dead-ends.
  - Provide sufficient funding to NHS assets to remain penalty free with respect to targets for asset condition and performance of the NHS in accordance with 23 U.S.C. 150(d).

# Investment Strategy Program Development

Annually, LADOTD's Secretary and the Executive Committee meet to review the investment strategies used to update the annual budget partitions that are projected for the next ten years. The process includes a review of the following information:

- Past performance of the system
- Pavement and bridge needs
- Available funding
- Policies & procedures supporting a life cycle based asset management approach
- Asset inventories
- Pavement and bridge investment funding scenario forecasts
- Level of service targets

# Investment Strategy Program Development (cont)

- Using this information and considering the recommendations of the Asset Management Engineer and the TAM Steering Committee, the Secretary and the Executive Committee will consider whether or not to adjust the investment strategies.

- The final set of investment strategies are communicated to LADOTD's personnel via the annual Highway Budget Partitions and the project selections within the annual Highway Priority Program.

# Defining Investment Scenarios

- How can current available funding for asset management activities change in the future?

- Federal requirements for state DOT TAMPs call for the development of at least the following three (3) scenarios per 23 CFR 515.7(d)(1-4).

  – Scenario 1: Funding that is estimated to be reasonably available.
  – Scenario 2: Funding required to achieve federal performance targets.
  – Scenario 3: Funding required to maintain asset value.

–

# Defining Investment Scenarios (cont)

- NCHRP Report 898 also identifies the following additional scenarios for consideration.
  - Current Funding Level.
  - Funding required to maintain current asset conditions and performance.
  - Alternative funding levels.
  - Consideration of selected risks.

# LADOTD Investment Scenarios

- Historical Approach: In the past, LADOTD set budgets based on historical levels and adjusted those levels based on explicit needs of assets facing critical issues or mandates. This often supported the "worst-first" approach.

- Updated Approach: This analysis began with a PMS and BMS evaluation of the outcome of the previous budget level, using the estimated cost of expected future work types to assess future conditions of pavement and bridge assets. Funding was adjusted to achieve each of the goals of Louisiana DOTD TAMP steady state funding, or DSGR, state performance targets and federal goals. The final outcome is a proposed budget that maximizes the life cycle of the various NHS asset classes.

# LADOTD Investment Scenarios(cont)

- Initial Current Funding Scenario Evaluations: Starting with the previous budget allocations the management systems were used to assess the future conditions of the pavement and bridge assets.
- Initial Results: It was immediately apparent that these previous funding levels could not achieve the pavement or bridge condition targets and would result in significant performance gaps, as well as condition states above the minimum Interstate Pavement or NHS Bridge requirements, leading to future penalty assessments. The existing budget allocations could not maximize the life of these assets.
- Alternative Funding Scenario Evaluations: Following that realization, a number of different funding scenarios were then evaluated against both federal goals, state condition targets and steady state or state of good repair goals, to identify appropriate issues and performance gaps that could prevent LADOTD from reaching those targets.

# LADOTD Investment Scenarios

| SFY 2020-21 TAMP Budgets (millions) | | |
|---|---|---|
| Asset Class | ^Budget Totals | Management System Analysis Funding |
| *NHS Pavements | | |
| Interstate | 35 | 33 |
| Non-Interstate NHS | 90 | 83 |
| *NHS Bridges | | |
| State NHS | 134 | 101 |

^ = Includes Preconstruction and Construction, Engineering, Inspection (CE&I) totals

* = Excludes Local NHS Pavements & Bridges

LOUISIANA DEPARTMENT OF TRANSPORTATION & DEVELOPMENT

# Investment Strategies Accomplish 23 CFR 515.9(f) Requirements

- Based on these extensive funding evaluations, LADOTD was afforded a preemptive opportunity to set pavement budget levels that not only achieved the funding required to meet federal performance targets (scenario 2), but also the funding required to maintain asset value, which is LADOTD's defined state of good repair (DSGR).
- As clearly stated above, LADOTD believed the same had been accomplished for NHS bridges (scenario 3).
- The position is also being taken that this funding will be reasonably available (scenario 1) as long as the Legislature is able to provide sufficient state funds to make the required federal match.

# Project Selection

- **NHS Pavements.** With respect to Interstate and Non-Interstate NHS pavements, the primary source of information for future project selection will be the recommendations created through this effort using the PMS. The recent adoption of the headquarters-based Interstate project selection methodology for the Non-Interstate NHS project selection will ensure a consistent TAM LCP based approach.
- **NHS Bridges.** With respect to NHS bridges, the historical and projected bridge NBI condition data will be used as a guiding source of information for future project selections. The intent will be to focus on keeping fair bridges in fair condition and good bridges in good condition.
- Integrating the Highway Safety Improvement Program (HSIP) and the Louisiana Freight Mobility Plan in the future will further improve cross-asset resource allocation in project selection strategies.
- This will allow project selection efforts to ensure a more TAM LCP based approach going forward, which will help to ensure that the "looming wave of aging bridge assets" (from the late 1950's, 1960's, & 1970's) will be addressed with the limited available funds.

# REFERENCES
## Investment Strategy basis from 23 CFR 515.7 Process for Establishing the Asset Management Plan.

- **Federal Requirement per 23 CFR 515.7(e)** A State DOT shall establish a process for developing investment strategies meeting the requirements in 23 CFR 515.9(f). This process must result in a description of how the investment strategies are influenced, at a minimum, by the following:

(1) Performance gap analysis required under 23 CFR 515.7 (a);

(2) Life-cycle planning for asset classes or asset sub-groups resulting from the process required under 23 CFR 515.7 (b);

(3) Risk management analysis resulting from the process required under 23 CFR 515.7 (c); and

(4) Anticipated available funding and estimated cost of expected future work types associated with various candidate strategies based on the financial plan required by 23 CFR 515.7(d).

# REFERENCES
## Investment Strategy basis from 23 CFR 515.7 Process for Establishing the Asset Management Plan (cont.)

**Federal Requirement per 23 CFR 515.9(f),** an asset management plan shall discuss how the plan's investment strategies collectively would make or support progress toward:

(1) Achieving and sustaining a desired state of good repair over the life cycle of the assets,

(2) Improving or preserving the condition of the assets and the performance of the NHS relating to physical assets,

(3) Achieving the State DOT targets for asset condition and performance of the NHS in accordance with 23 U.S.C. 150(d), and

(4) Achieving the national goals identified in 23 U.S.C. 150(b).

# Questions?

"If you have an opportunity to make things better and you don't, then you are wasting your time on earth."

Roberto Clemente

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DOTD
LOUISIANA DEPARTMENT OF TRANSPORTATION & DEVELOPMENT

NEW YORK STATE OF OPPORTUNITY. Department of Transportation

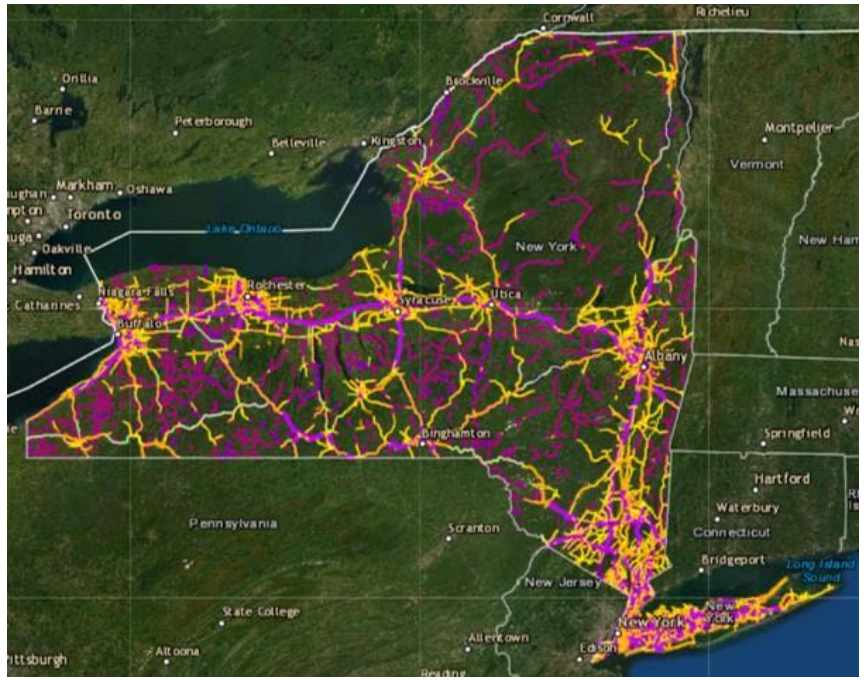
# Asset Trade Off Analysis Lessons Learned at NYSDOT

Transportation Asset Management Group

June 2021

# ATOA Goal

## Maximize the benefit of a given mixture of pavement and bridge programs




Benefits, determined by the ATOA Team, could include:

- System-wide asset condition
- Reduced maintenance costs
- Traffic mobility
- Reductions in construction impacts, greenhouse gas emissions, etc.

ATOA Team must have consensus from all stakeholders on

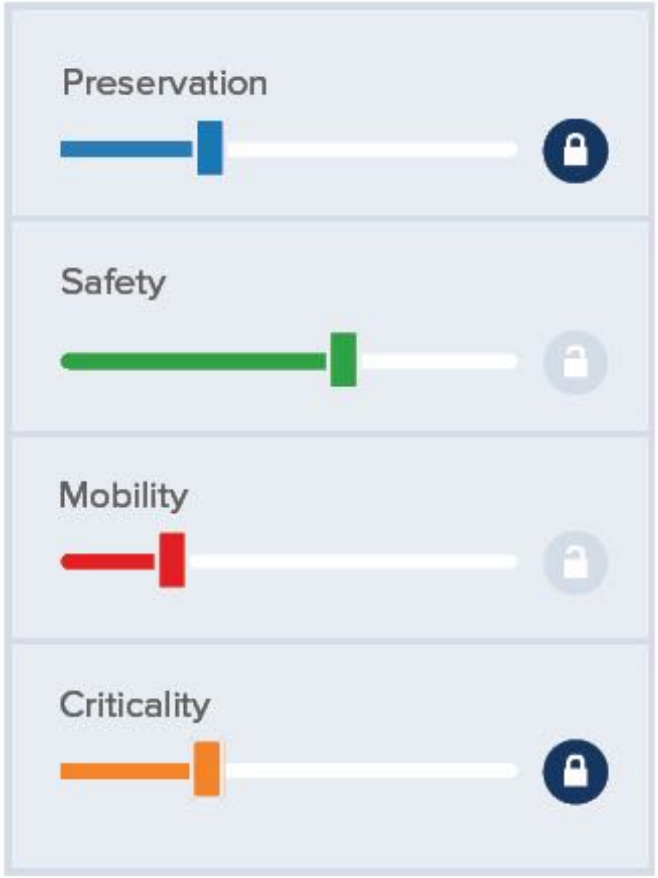
- Benefits to be measured
- Relative weighting between them
- Benefit formulas/curves for each factor

NEW YORK STATE OF OPPORTUNITY. Department of Transportation

# Inspired by Utah's Experience

Utah trades off using four categories:

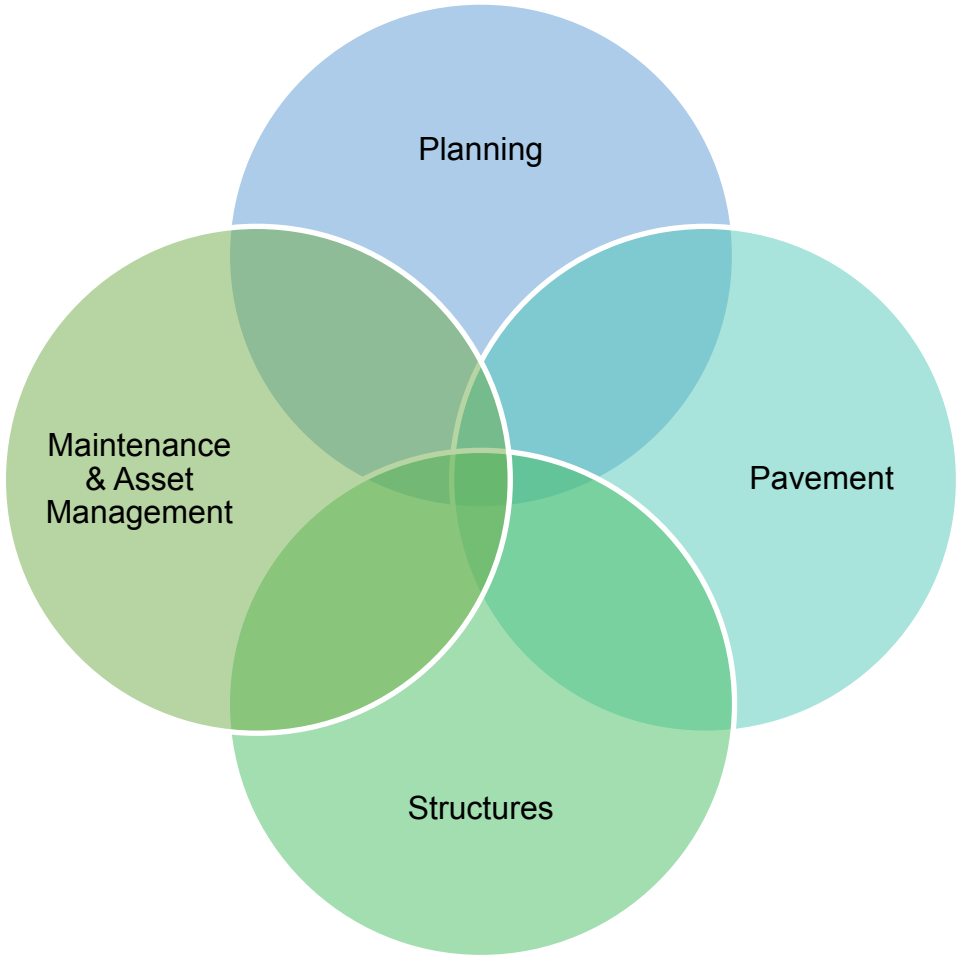
- Preservation of the System
- Keeping the System Safe
- Improving Mobility
- Making Strategic Investments




| ALTERNATIVE | VALUE | DISTRIBUTION |
|---|---|---|
| Interstate 76 Add Lane Capacity | .93 | |
| Construct Park and Ride Facility along... | .85 | |
| Interstate 10 Bridge Replacement and... | .84 | |
| ATMS Implementation approaching... | .80 | |
| Interstate 80 Corridor Reconstruction | .75 | |
| Interstate 76 Managed Lanes | .74 | |
| Interstate 70 Safety Enhancements | .72 | |
| Interstate 70 Pavement Rehabilitation... | .67 | |
| Interstate 280 Bridge Seismic Retrofit | .64 | |
| State Route 43B Bridge Replacement | .62 | |
| State Route 60 TWLTL Construction | .55 | |
| US Route 101 River Bridge Reconstruction | .45 | |
| Interstate 5 Major Rehabilitation | .31 | |
| State Route 50 Deck Replacement and... | .22 | |

*Source DECISION LENS CUSTOMER SUCCESS - Utah Department of Transportation*

# ATOA at NYSDOT




Start simple – Pavement vs Bridges

Team Comprised of three senior staff from respective program areas: Planning, Structures, and Pavement

Brainstormed factors to be considered in measuring the benefits of a program

Weighted factors against each other to develop utility functions to capture overall system performance

Utility function based – facilitated by an outside consultant; driven by condition state triggers and backlog

# Criteria Development

Symmetrical Criteria used for Bridges and Pavement

- Maintenance Focus – Change in Backlog
- Condition Focus – Prevent Condition State Transitions from Higher to Lower
- User Focus – Percent Poor

# NYSDOT Priority Weights

Used a Pairwise Comparison Process to:

- Elicit the relative importance of each factor from the cross functional program experts
- Gain consensus on the weights

| Criteria | Priority Weight |
|---|---|
| Bridge | **55%** |
| Pavement | **45%** |
| | |
| Bridge Backlog | 22% |
| Bridge Fair Protective to Fair Corrective | 5% |
| Bridge Fair Corrective to Poor | 14% |
| Bridge Poor | 14% |
| | |
| Pavement Backlog | 29% |
| Pavement Fair to Poor | 4% |
| Pavement Good to Fair | 8% |
| Pavement Poor | 5% |

# Program Level ATOA Process

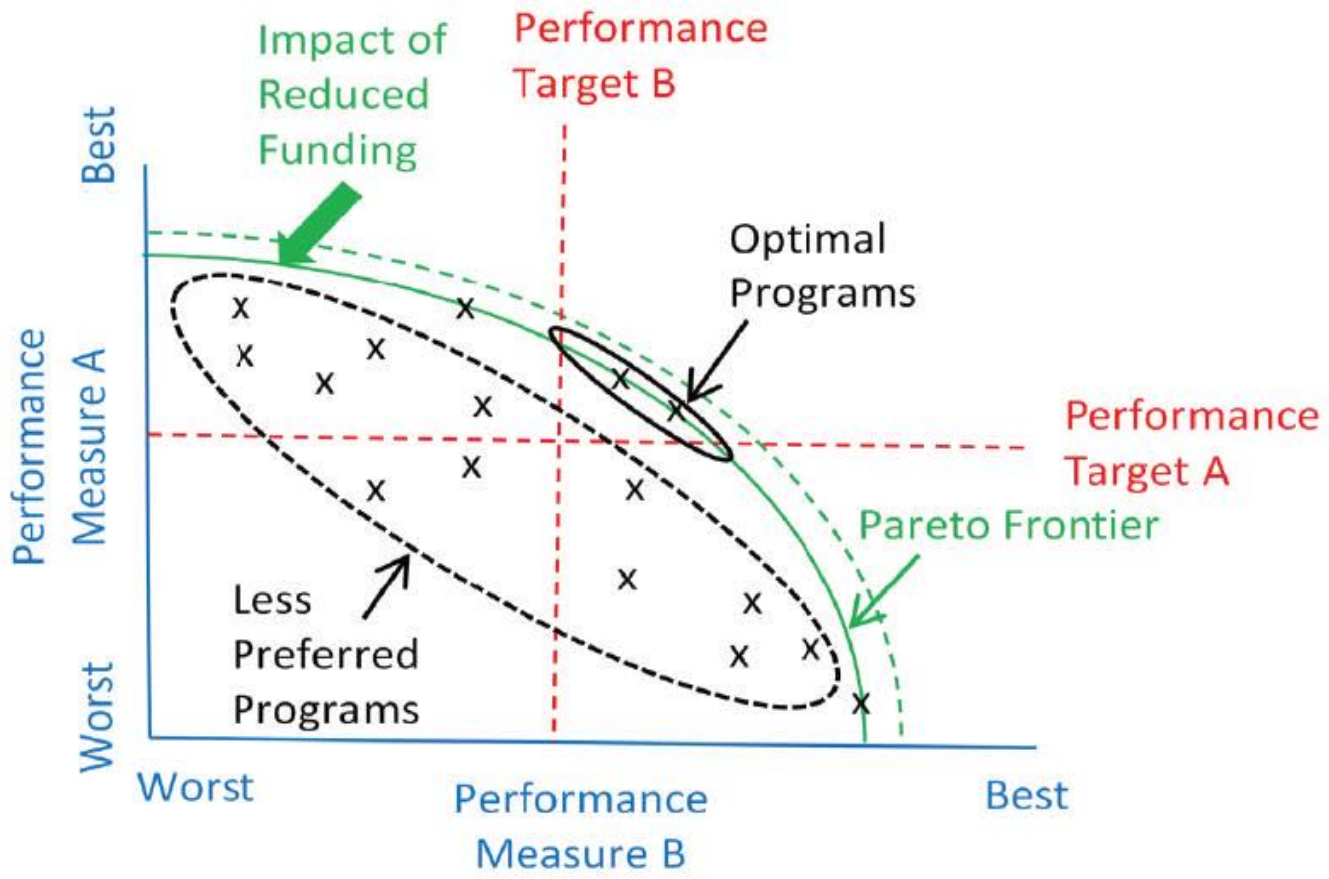
- Run Pavement Model and Bridge Model to get optimum results for a range of funding levels for each asset. Run each asset at $100M, $200M, $300M, etc.
- Then combine them in different scenarios to meet an overall budget constraint of $1B and measure the overall benefit of each combination.
  - $200M Pavement / $800M Bridges
  - $300M Pavement / $700M Bridges, etc.

# Program Level Trade Off Analysis – The Performance Frontier

Combines *Utility Results* from each asset performance category based on various funding allocations for optimized programs for an overall budget

Pareto Frontier is the curve created by the highest utility created for each funding level

*Source: NCHRP 806, "Cross Asset Trade Off Analysis"*



# Optimized Performance Outcomes

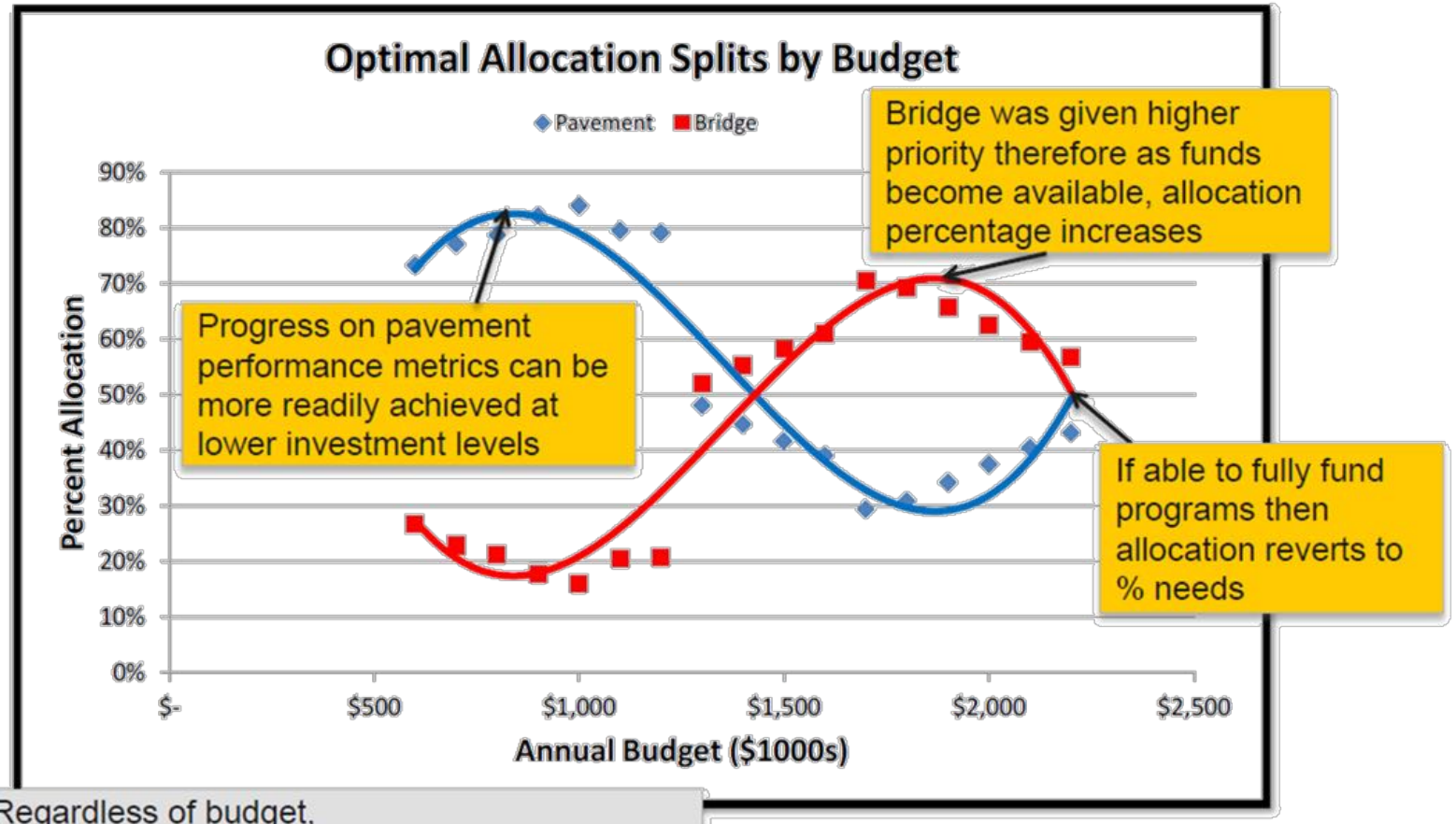
## Key Learnings:

Pavements deteriorate very quickly but are less expensive to treat

Bridges deteriorate slowly but are expensive to treat

Pavement GASB 34 Value is more than twice the Bridge Value

Model indicates initial funding should be heavily weighed to Pavements and only if the annual budget exceeds $1.5B would Bridges be funded more than pavements

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# Data Modeling vs Tradition and Experience

Maximize diversity of program area input / business perspectives

Data driven ATOA results help inform complex governance and program planning processes

- Pre-existing biases towards conservative planning approaches and engineering judgement
- ATOA creates winners and losers
- What happens when results run counter to what you've done historically?

**How do you handle data driven results that conflict with funding history and program area interests?**

NEW YORK STATE OF OPPORTUNITY. Department of Transportation

# Thank You

# Caltrans Project Prioritization Efforts Using MODA

**Michael Johnson**
**State Asset Management Engineer**
**California Department of Transportation**

**June 2021**

# Acknowledgements


- Caltrans MODA efforts presented today are a compilation of efforts over 7 years.  The following individuals or firms contributed to the various efforts presented today.

- (2014 Initial work) - Loren Turner, Donna Berry, Steve Guenther, Dr. Ralph Keeney
- (2016 funded pilot) - Mike Johnson and Hamid Sadraie
- (2018 Review of Pilot) - Spy Pond Partners, William Robert, Dr. Ralph Keeney, Dr. Alex Engau, Dr. Arnold Barnett, Paul Thompson,
- Monetization of Benefits – Spy Pond Partners, Shalini Chandra, Dawn Foster, Loren Turner, Mike Johnson
- 2021 - Cross Asset Optimization with Risk – Dr. Mahmoud Halfawy, Dawn Foster, Mike Johnson, Loren Turner

# Motivation for Improvement

- Legacy approach to prioritizing
  - involved setting budgets by asset class or program category
  - Prioritization occurred within each category

- Challenges
  - Establishing funding level for each asset class or category
  - Encouraging projects that address multiple asset classes or program categories
  - Incorporating needs of all stakeholders in the process (silo program perspective)
  - Aligning project portfolios with Caltrans' strategic objectives

- In 2014 Caltrans began evaluating an improved approach to prioritizing SHOPP projects using MODA

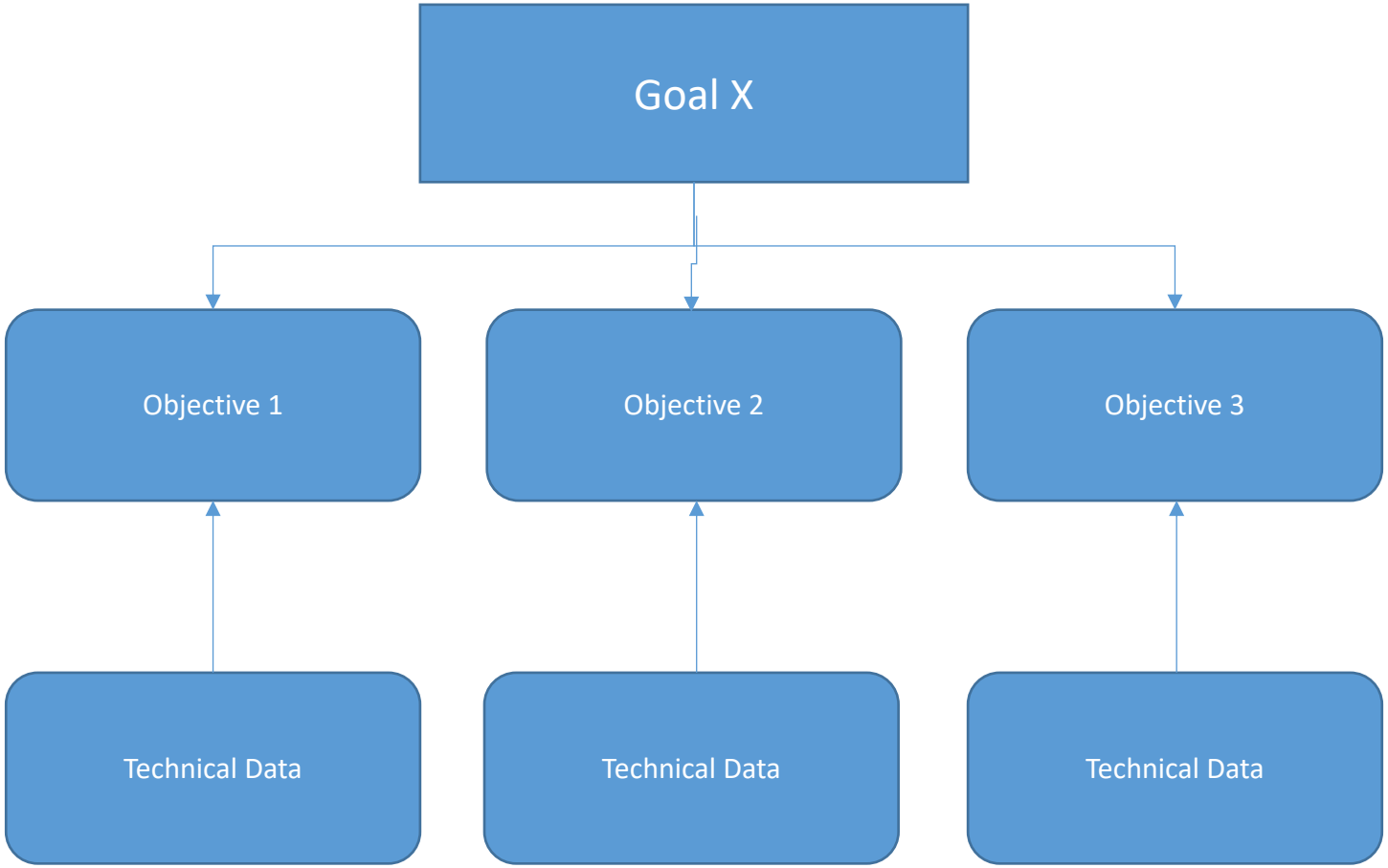
# About Multi-Objective Decision Analysis (MODA)

- Data-driven approach for making decisions considering competing objectives
- Requires defining a formal hierarchy of objectives and quantifying progress towards these objectives for each candidate project

# Advantages of a MODA-Based Approach

- Brings transparency to the project prioritization process
- Logical, quantitative, and data-driven basis for investment decision-making
- Traceable framework to communicate the alignment of project priorities with strategic objectives
- Identifies best projects across asset types (or “silos”) based on calculated value and cost

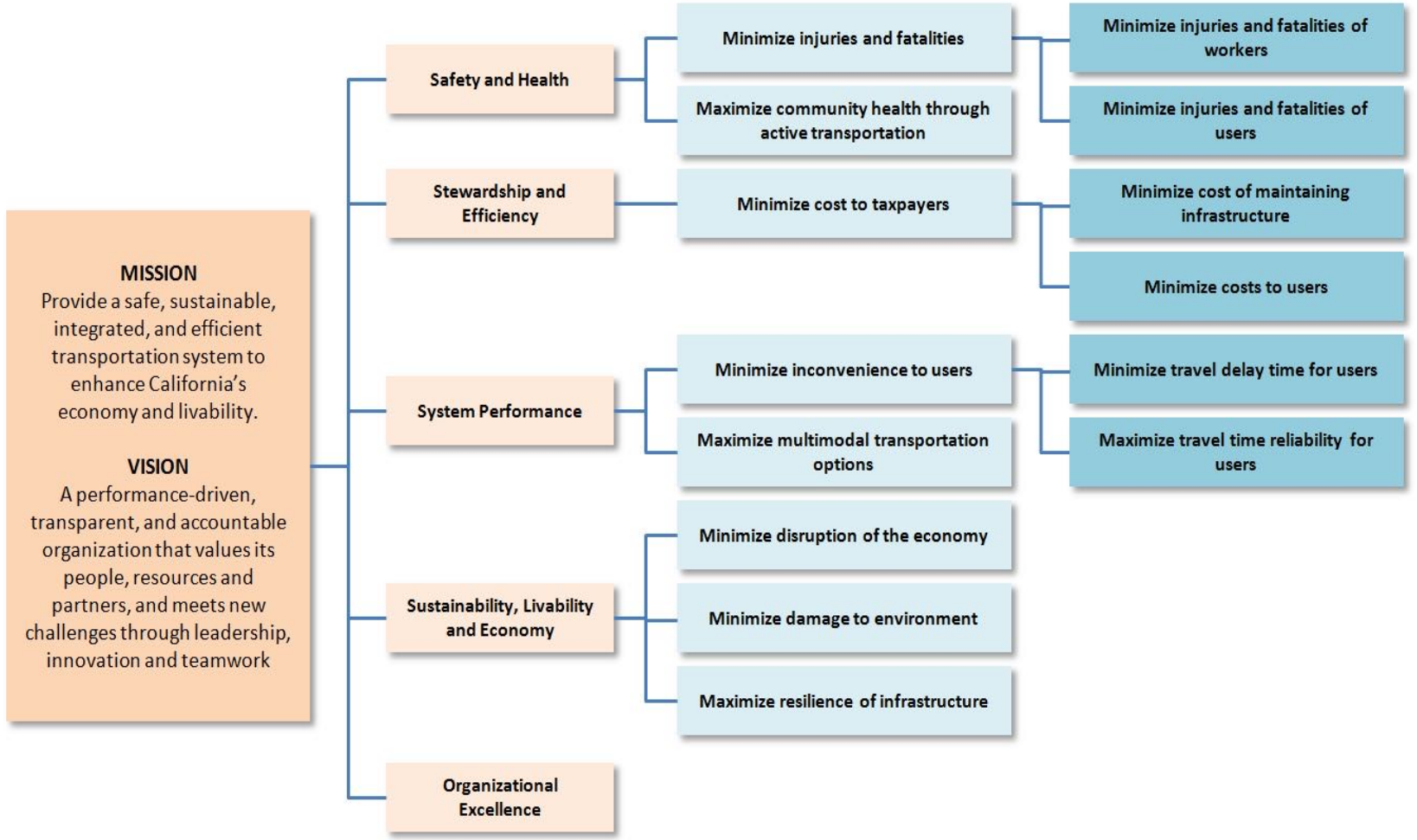
# Multi- Objective Conceptual Diagram



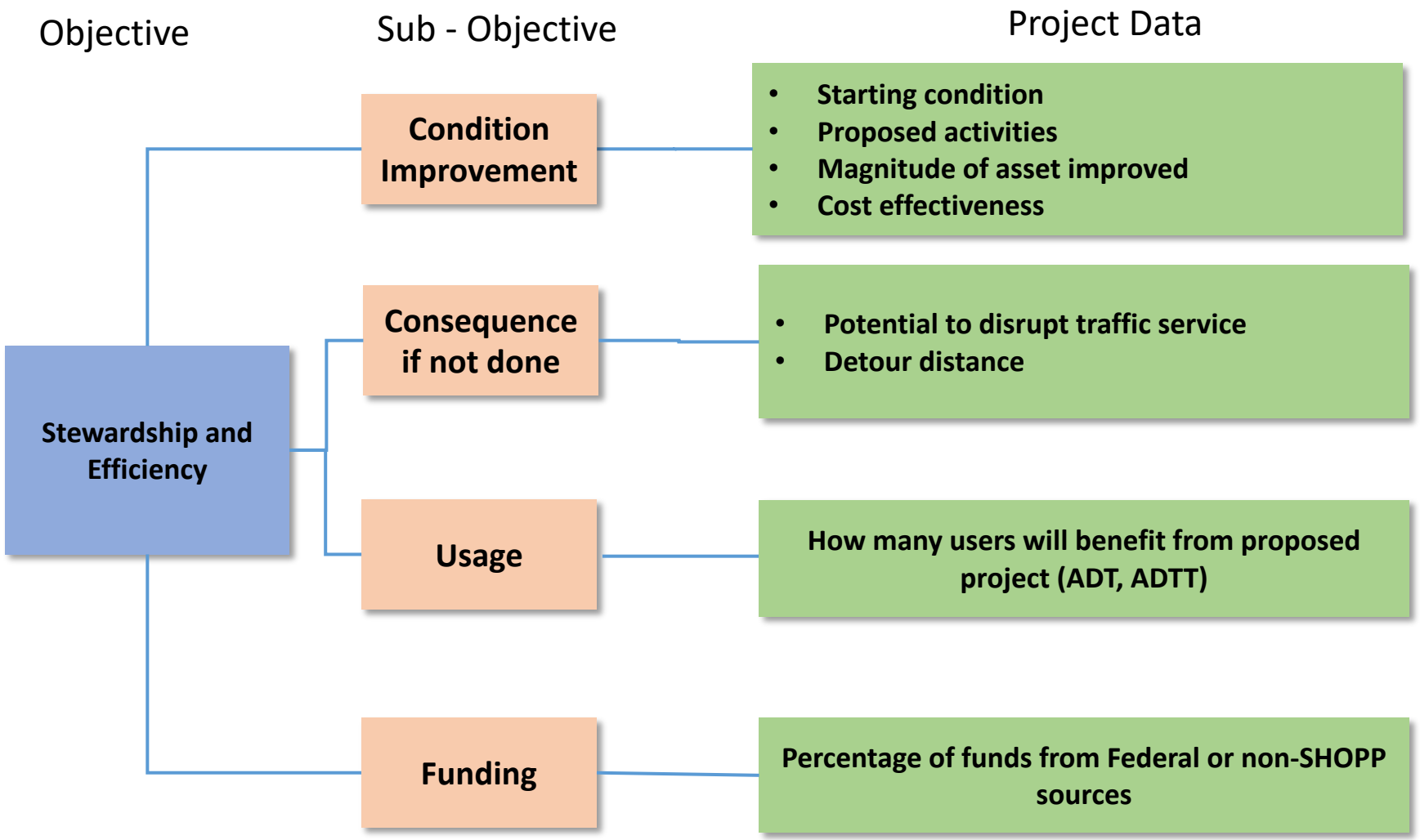
# Caltrans MODA Framework

**MISSION**
Provide a safe, sustainable, integrated, and efficient transportation system to enhance California's economy and livability.

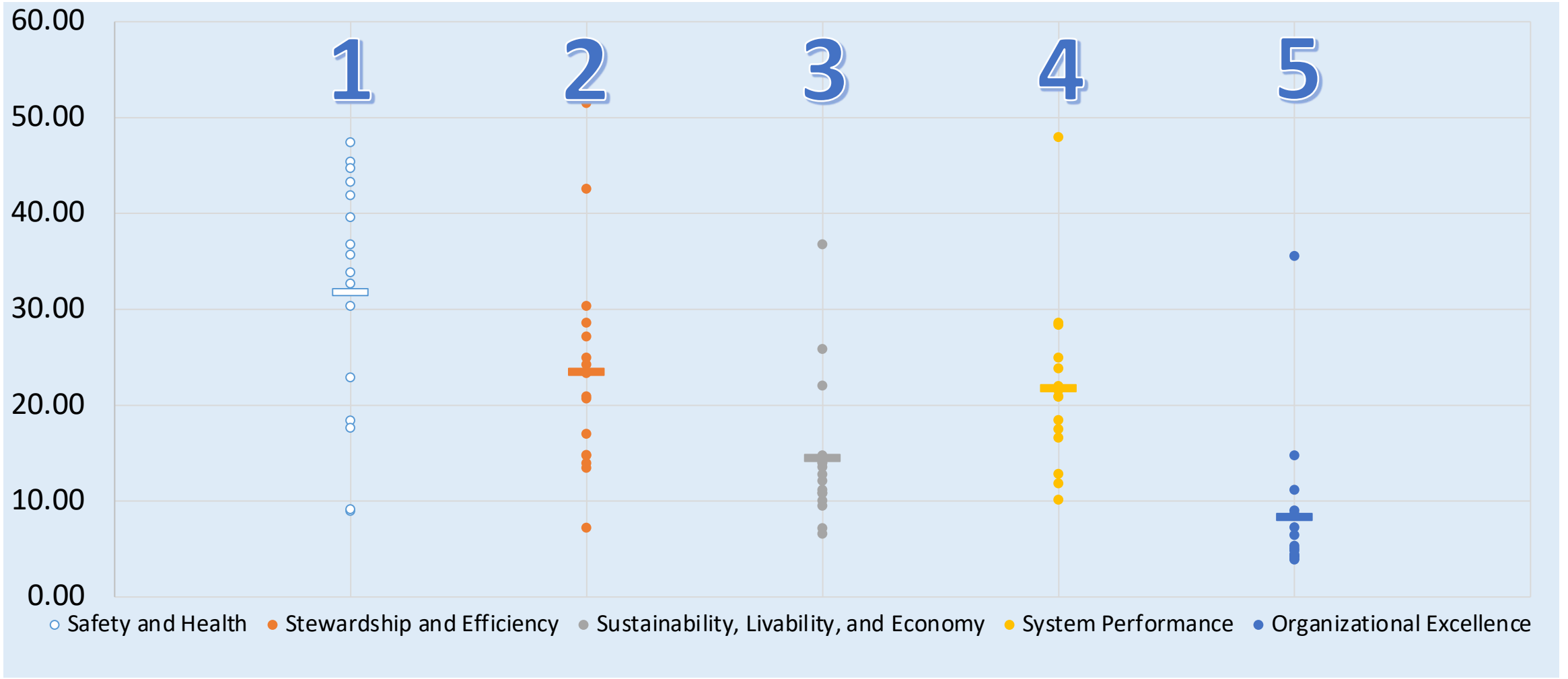
**VISION**
A performance-driven, transparent, and accountable organization that values its people, resources and partners, and meets new challenges through leadership, innovation and teamwork



# MODA Pilot – Stewardship and Efficiency



# Goal Weighting – Analytical Hierarchy Method



# Initial MODA Efforts (2014 & 2016) Lessons Learned

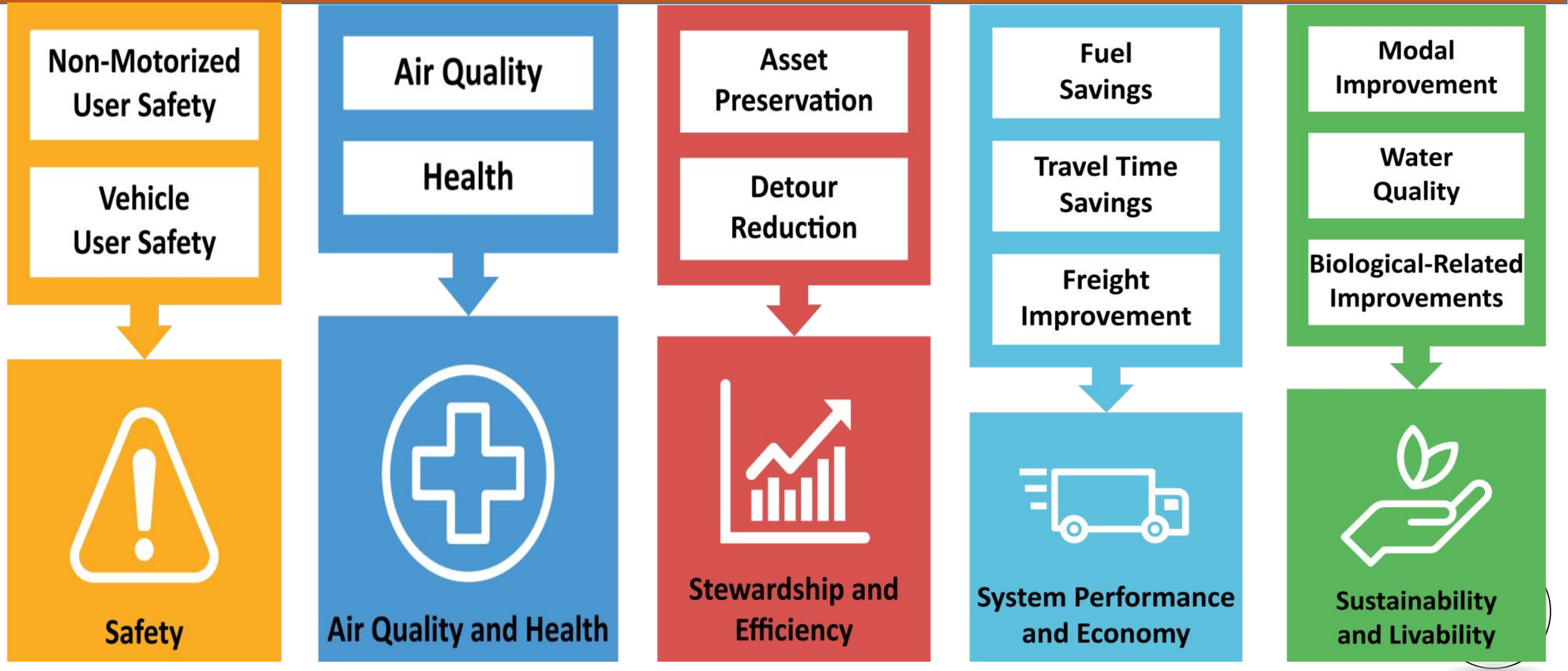
- Development of comprehensive objective hierarchy is challenging
- Normalizing objective hierarchy metrics is challenging
- Weighting of objectives is varied significantly among executives and external reviewers
- Weighting objectives favors multiple objective projects
- Goal weighting lack of consensus
- Scaling benefits is challenging especially for project size and scope
  - Risk mitigation example

# Benefit Monetization

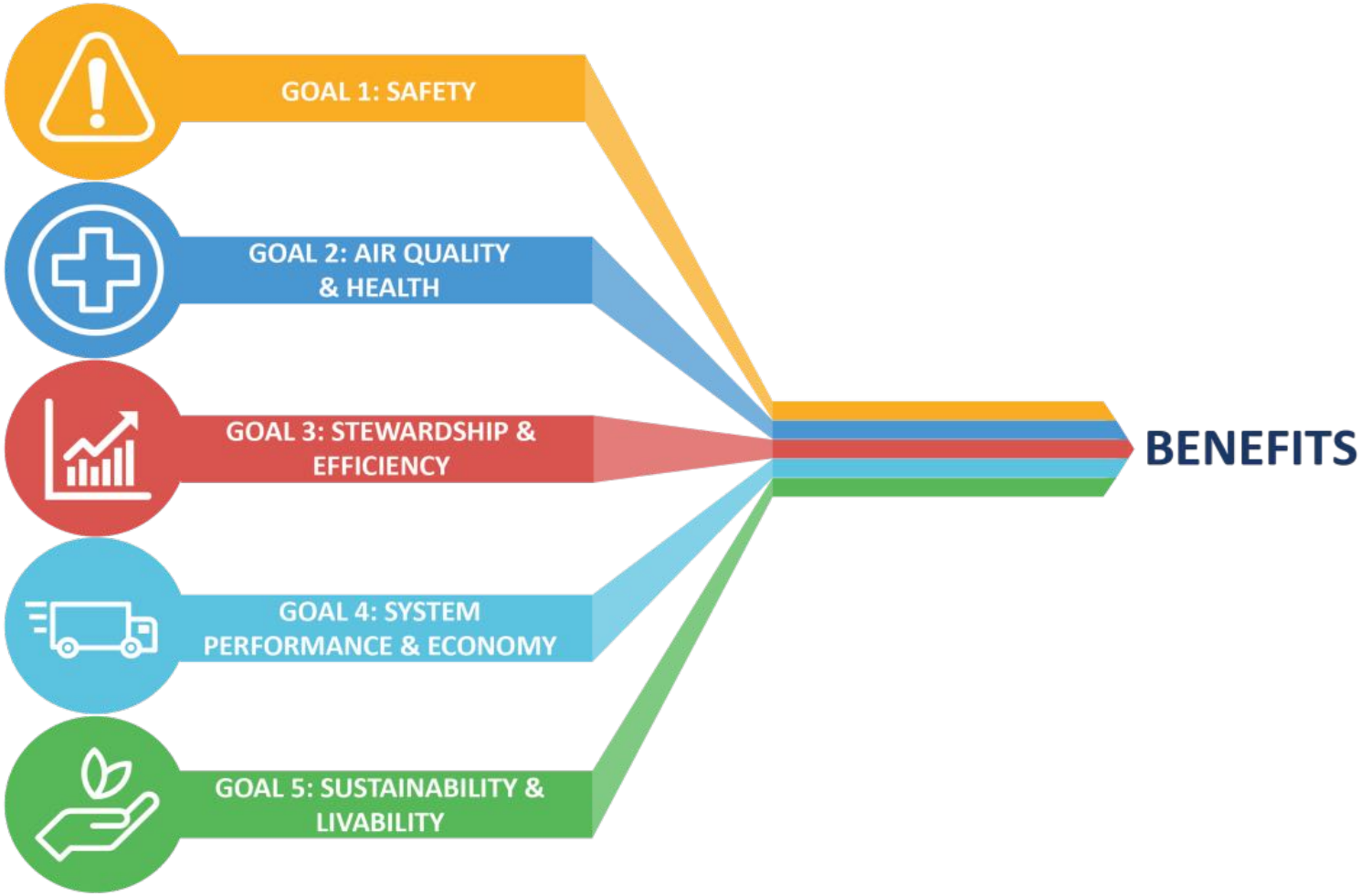
- Advantages
  - Overcomes many of the challenges associated with weighting

- Challenges
  - Monetizing benefits can be very difficult to quantify
    - Vulnerability mitigation (Safety, Seismic risk mitigation)
    - Usage based objectives (ADA for example),
    - Environmental objectives (GHG reduction for example)
  - Still has scaling challenges
    - Example – Scour mitigation of a large bridge versus small

# Improved Objective Functions



# Recommended Approach




- 5 goals and 12 objectives defined based on Caltrans' Strategic Management Plan
- Methodology defined for each objective for calculating annual monetized benefit of performing a candidate project vs. deferral

# Multi-Objective Project Benefits

# Monetization Annual Benefit Calculation - Example

| Goal | Objective | Utility (Annual Benefit, $) |
|---|---|---|
| Safety | Non-Motorized Vehicle Safety | 13 |
| | Vehicle Safety | 55,824 |
| Air Quality and Health | Air Quality | 471 |
| | Health Activity | 209 |
| Stewardship and Efficiency | Preservation | 426,173 |
| | Reduced Detours | 74,348 |
| System Performance and Economy | Fuel Savings | 2,974 |
| | Travel Time | 28,664 |
| | Freight Corridors | 5,928 |
| Sustainability and Livability | Modal Improvement | 1,322 |
| | Water Quality | 41,140 |
| | Biological Improvement | 0 |
| **Total** | | **735,167** |

# More Recent MODA Work

- Evaluated various optimization techniques
  - Dr. Alex Engau proposed three approaches and evaluated pro's & con's of each
- Incorporation of Risk in the Value Functions
  - Dr. Mahmoud Halfawy
- Cross Asset Optimization including Risk (pending final report)
  - Infrastructure Data Solutions
- Copperleaf – C55
  - Software tool largely in the power industry that we are looking at the MODA framework and potential for implementation

# Questions

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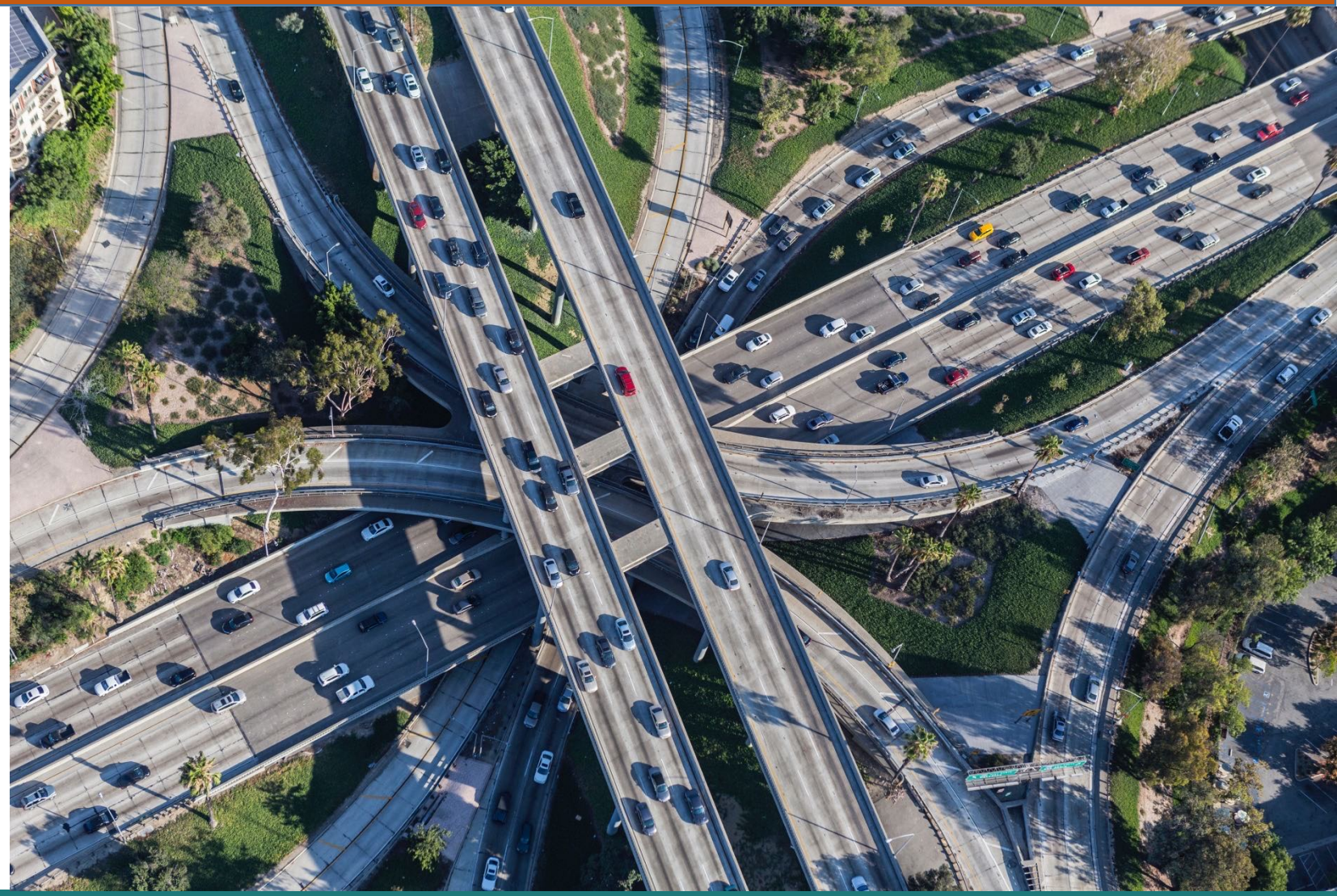

# AASHTO TAM Guide Book Club
## Quest

Your agency's director called to congratulate on your new assignment to lead development of the agency's next NHS TAMP. She noted that she recently reviewed FHWA's TAMP requirements as part of her summer reading, and that one thing that caught her eye is FHWA's definition of an investment strategy.

She asked you to explain how you will go about developing an investment strategy for the TAMP. She also asked whether it would be possible to use of MODA to improve how investments are prioritized in the agency's investment planning.

**Address the following questions to prepare for the meeting with the director to communicate how to move forward with her requests.**

- **What options for investment strategies** would you suggest exploring to develop your agency's TAMP? *The FHWA definition suggests that developing investment strategies requires evaluating different options, such as different levels of funding.*
- **What steps will you need to take to implement the use of MODA** to develop TAM investment strategies? *Assume that your agency does not currently have a prioritization process based on MODA.*
- **What information or tools will you need** to help develop an investment strategy?
- **What information from the TAM Guide** will help with investment strategies development?
- **Are there any additional resources** you'd like to have that is missing from the TAM Guide?

# Quest Breakout Session
## Feedback

- How did you answer each of the questions?
- What are your thoughts on how we can improve the value of the Guide based on the quest?
  - Updated resources?
  - Sharing new practices?
  - Linking to new guidance?
  - More resources to support the 2022 TAMP development?

# Open Discussion

# Q & A

# Full Schedule and Registration Information

https://www.tam-portal.com/event-directory/tam-webinars/

**8. Strengthening How Data Supports Your TAM Program**
Wednesday 6/16/21 - 2:00 – 3:30 PM eastern time

**To register:**
**https://www.tam-portal.com/event-directory/tam-webinars/**

**To access the Guide:**
**TAMGuide.com**

**Questions?**
**Contact Hyun-A Park or Matt Hardy for more information:**
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