Utah Transportation Asset Management Plan

Utah TAMP

January 2016

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Introduction

Utah Department of Transportation (UDOT) is focused on preserving Utah's existing transportation infrastructure; the state's multi-billion dollar investment in roads, bridges and other assets must be maintained for future generations. Keeping Utah's assets in good condition is the most effective way to extend the life of the transportation system.

Expanding and preserving the transportation system requires improved efficiency, careful use of resources and close partnering with decision makers. By focusing on the Strategic Goals, UDOT will meet the challenges of an ever growing and changing state. UDOT's Roadmap lays out the mission, vision, strategic goals, emphasis areas, and core values. This roadmap is the guidance for asset management.

Strategic Goals

1 Preserve Infrastructure
2 Optimize Mobility
3 Zero Fatalities
4 Strengthen the Economy

Figure 1 - Strategic Goals

Asset Management is a crucial element of achieving these Strategic Goals. The Asset Management process helps UDOT to be accountable to the public by:

- Minimizing lifecycle costs
- Maximizing system performance
- Supporting an objective decision making process
- Balancing public expectations with limited funding

Unified Approach

UDOT is moving toward a unified approach regarding investment decisions to comply with the requirements of MAP-21 and maximize resources. UDOT has well established processes in place for managing pavement and bridge preservation and plan to expand these efforts to other assets. Up to this time, recommendations for the investment of UDOT's resources have been based on each asset funding category and program. To improve the strong efforts already made with bridges and pavement, UDOT is reconfirming existing asset management strategies and providing a comprehensive view of the asset management process. The unified approach includes

Areas of evaluation for unified approach to Asset Management:

- Performance-based approach for allocating funds,
- Organizational structure for asset management,
- Data storage and accessibility,
- Asset management ties to the long range plan,
- Lifecycle cost analysis, and
- Risk management.

Figure 2 - Asset Management Evaluation

evaluation of multiple areas of analysis and structure.

Development of the 2014-2019 Transportation Asset Management Plan (TAMP) provides UDOT with an integrated, comprehensive and strategic approach to meet transportation needs while keeping the current system in good condition. The strength of this data-driven plan is that it demonstrates results, accountability, and transparency. Decisions are supported by the data generated in UDOT processes, sound engineering judgment and evaluation of transportation needs across Utah. The Utah TAMP provides a systematic framework and answers resource management questions such as:

- How should each asset be managed and what are the risks involved?
- What is the funding and performance relationship between different assets?
- What are the long term implications of asset related decisions made today?
- What long term funding is needed to maintain least cost asset condition?

In order to identify the steps to raise UDOT asset management to a gold standard, the oversight committee structure was revised and a self-assessment gap analysis was completed. The current oversight committee structure is included in Appendix A. The gap analysis process and results are in Appendix B. Committee member comments from the program self-assessment are included in Appendix C.

The result of the gap analysis and program assessment is a five year roadmap for UDOT asset management that embraces MAP-21 and UDOT goals of preserving infrastructure with a transparent, performance-based approach.

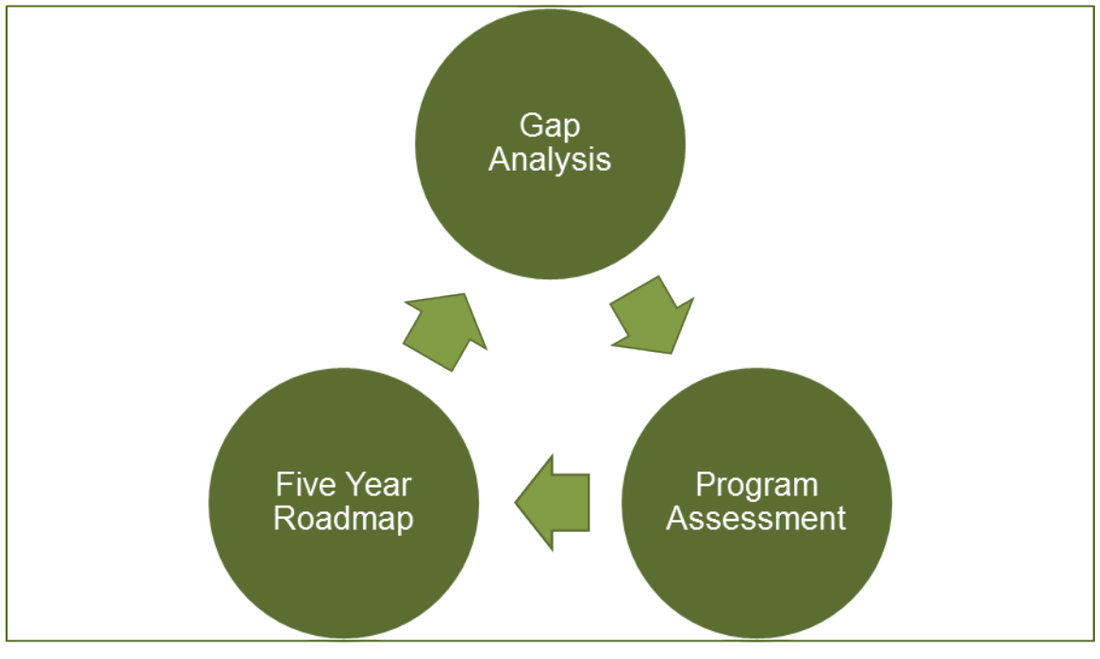

Figure 3 -Gap Analysis Flowchart

Asset Management Roadmap

Goal and Objectives

To effectively manage UDOT's assets, the Asset Advisory Committee established a goal to create a unified program that maximizes system performance and funding. Evaluation of the gap analysis results and categorization of program assessment comments resulted in the identification of three areas of focus;

- integrated programs,
- performance management, and
- organized and accessible data.

These areas create the framework for the Utah TAMP.

The overall goal for the Asset Management Team is to work collaboratively to develop a unified program that maximizes system performance and funding within the next five years. The reorganized AMSC and AAC identified and approved goals and objectives for the purpose of continuous improvement of asset management within UDOT. Objectives for 2015-2019 in 1, 3, and 5 year timeframes in each of the three major categories have been identified to reach this goal as shown in Figure 4.

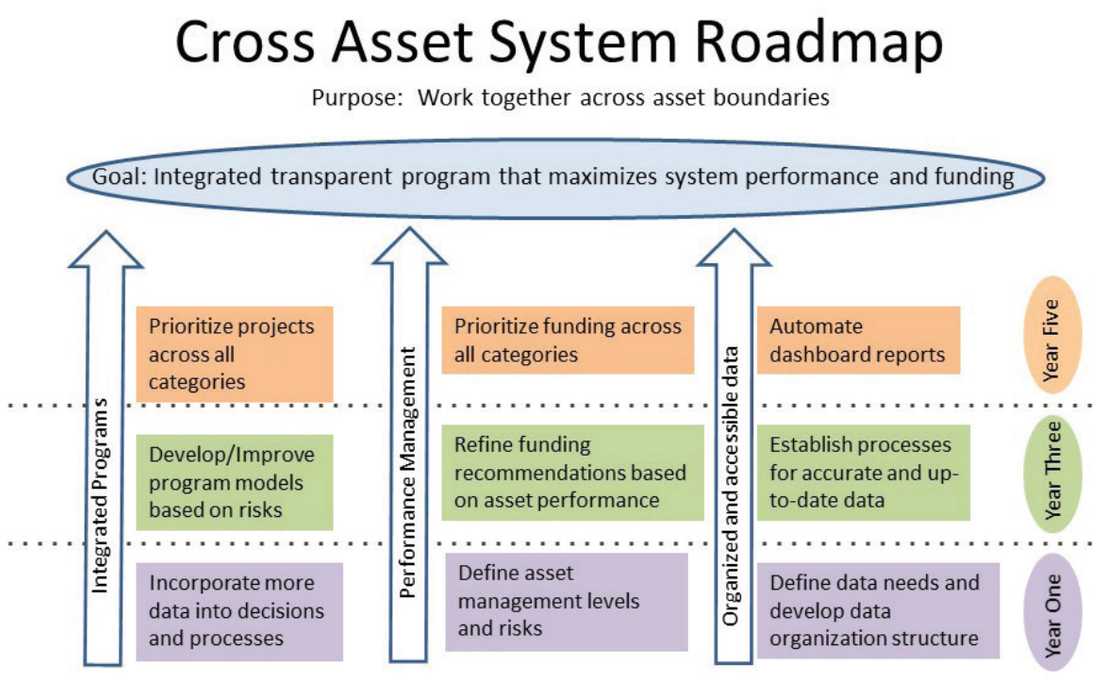

Figure 4- Asset Management

Implementation Plan

Each UDOT division and the Committees are working separately and collectively to fulfill the objectives and needed tasks to accomplish the roadmap goal. Following is a summary of work associated with each category and an overview of the roadmap by year.

Integrated Programs

Consolidating data collection of several individual divisions into a single bi-annual contract was the kick-off to an integrated program. Further collaboration between UDOT divisions is planned and required to develop the ability to prioritize projects irrespective of specific funding categories. This collaboration involves establishing the replacement value of each asset and developing a financial model with life cycle costs for selected high value assets. It also involves completing the information loop of project planning, design, construction and maintenance. Developing this consistent loop of communication will improve the accuracy and efficiency of each separate process and thereby the overall UDOT program. It will also tie the Long Range Plan process and results to Project Development and the Region's Three Year Plans.

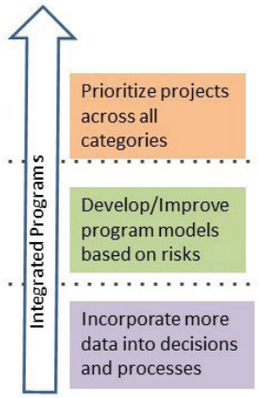

Figure 5 – Integrated Programs

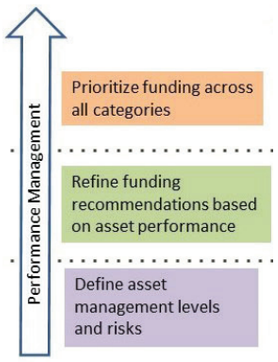

Figure 6 - Performance Management

Performance Management

Management plans currently exist for pavement and bridges and a variety of assets within the Maintenance Management Quality Assurance Plus (MMQA+) programs. The wealth of additional data now available due to the unified and automated collection process allows UDOT to evaluate conditions and develop a performance based plan that includes all assets to the level appropriate to the value and risk associated with each. Within the five years of the TAMP, UDOT will identify risks, performance measures and life cycle costs for numerous assets in a joint effort to better prioritize funding across all funding categories.

Organized and Accessible Data

The recent influx of data and information provides an opportunity and urgency for UDOT to develop a systematic approach and structure for data storage and access. The ability to import and export data to all existing and future business systems will lead to the ability to create interactive dashboards. Dashboards will be used by decision-makers at multiple levels to maximize system performance and funding. The structured and organized details associated with each data set will allow groups to reference any related data to make better decisions.

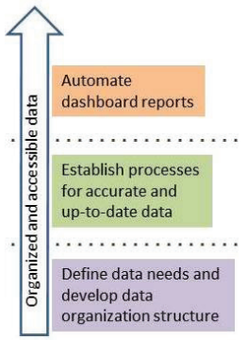

Figure 7 - Organized & Accessible Data

Plan by the year

Year 1 - During the first year teams will identify performance measures, define data needs, and initiate development of measures and information required for cross-asset analysis.

Year 3 - By the end of Year 3, models and processes for all programs will be developed and refined to promote collaboration. This will allow decision makers to make data driven decisions that are necessary to prioritize resources across categories.

Year 5 – The fifth year will include full automation of processes that exchange information from multiple sources and refinement of value definitions that support cross asset analysis.

Performance Driven Plan

UDOT develops performance management plans annually to link the strategic goals to resources and results. The Assets and Performance category of the roadmap applies performance management principles to UDOT's roadway assets. In order to maximize funding and time, UDOT has developed a tiered system to preserve, rehabilitate and maintain the transportation physical assets. Three tiers have been established and each asset is assigned to a tier based on value and risk.

Asset Management Tiers

Asset Management tiers range from one to three with tier one being the most extensive management plan for the highest value assets.

Tier 1

Assets in the tier 1 management level are highest value combined with highest risk of negative financial impact for poor management. These are assets that are very important to the UDOT performance plan success and are recommended for a significant separate funding source. Management plans for tier 1 assets include elements such as:

- Accurate and sophisticated data collection
- Targets and measures set and tracked
- Predictive modeling and risk analysis

Tier 2

Assets in the tier 2 management level are moderate value and substantial importance to transportation system operation. These assets have a moderate risk of negative impact for poor management or asset failure. They may have a separate funding source. Management plans for tier 2 assets include elements such as:

- Accurate data collection, less than annually

Table 1 - Asset Tiers

Asset	Tier
Pavement	1
Bridges	1
ATMS/Signal Devices	1
Pipe Culverts	2
Signs	2
Walls	2
Rumble Strips	2
ADA Ramps	2
Barrier	2
Pavement Markings	2
Cattle Guards	3
Interstate Lighting	3
Fences	3
Rest Areas	3
Curb and Gutter	3
Trails	3
Bike Lanes	3
Surplus Land	3
At-grade Railroad Crossings	3

- Risk assessment primarily based on asset failure
- Condition targets
- Possible spreadsheet management strategy

Tier 3

Assets in the tier 3 management level are generally the lowest value assets with the lowest risk of negative impact for poor management or asset failure. Management plans for tier 3 assets include elements such as:

- Accurate data collection, less than annually
- Risk assessment primarily based on asset failure
- General condition analysis
- Management involving repair or replacement when damaged

Performance Measures and Targets

The UDOT process requires measures and targets set and tracked for tier 1 assets which are pavement, bridges, and ATMS/Signal devices. This process meets and exceeds the MAP-21 requirements. UDOT Maintenance Division also has established measures and targets for some of the tier 2 and 3 assets and these are set and tracked as part of the Maintenance Management Quality Assurance Program.

Pavement

UDOT's measure for pavement condition is based on the International Roughness Index (IRI). UDOT translates IRI into a percentage called Ride Index for ease of understanding. Ride index of 0 equates to IRI greater than 250, Ride of 50 equals IRI of 170, Ride of 80 equals IRI of 95 and Ride of 100 equals IRI of 0, as shown below. UDOT has established performance targets for each pavement category to support achievement of national and UDOT goals. The targets for each pavement category are the minimum percentage of lane miles that rate good and the maximum percentage of lane miles that rate poor:

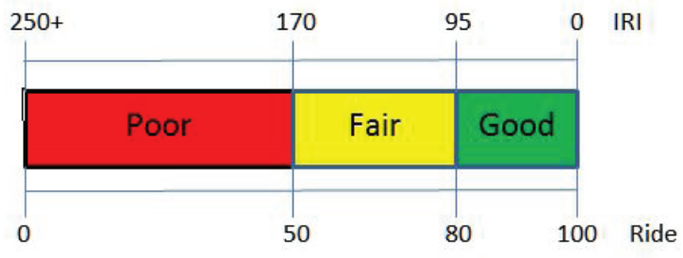

Figure 8 - Pavement Measure

- Interstate, > 80% good and < 1% poor
- NHS, >70% good and <5% poor
- High volume, >50% good and <10% poor
- Low volume, >30% good and <20% poor

Bridge

MAP-21 requires a state to devote resources to improve the condition of the National Highway System (NHS) until the established minimum is exceeded. The minimum standard for NHS bridges is that no more than 10 percent of a state's total deck area is on structurally deficient bridges. The bridge inventory in Utah well exceeds this standard.

UDOT uses the Bridge Health Index (BHI) as a measure to describe the overall condition of each bridge and is used as a tracking and planning tool. The BHI is calculated at the element level as a ratio of the value of the bridge in the bridge's current condition to the value of the bridge in the best possible condition. The BHI of an entire bridge is calculated as a weighted average of the health indices of the bridge elements, where elements are weighted by the total quantity of the element and relative importance. The BHI assigns weighting factors to each element depending on the relative importance of the element to the rest of the structure. The factors are the product of the element weight and element unit replacement costs. The Bridge Health Index is used as a tracking and planning tool for evaluating bridge needs and prioritizing funding. The BHI categories are:

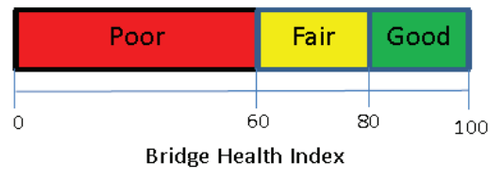

Figure 9 - Bridge Measure

- Good. 100-80
- Fair. 80-60
- Poor, 60-0

UDOT has set the following system Bridge Health Index targets.

- Greater than 85 for the NHS
- 85 to 80 for the State System
- 80 to 75 for the Local Federal Aid System

More information can be found in the Bridge Management Manual.

ATMS and Signal Devices

UDOT has set performance measures and targets for the signal system that encompasses operation, maintenance, design, and management. Currently these measures are tracked individually and reported weekly, monthly, or annually depending on the measure. UDOT's intent is to create a single measure for signal health that accumulates and reflects the existing areas of focus. Details of the current performance measures can be found in the Traffic Signal Management Plan (TSMP).

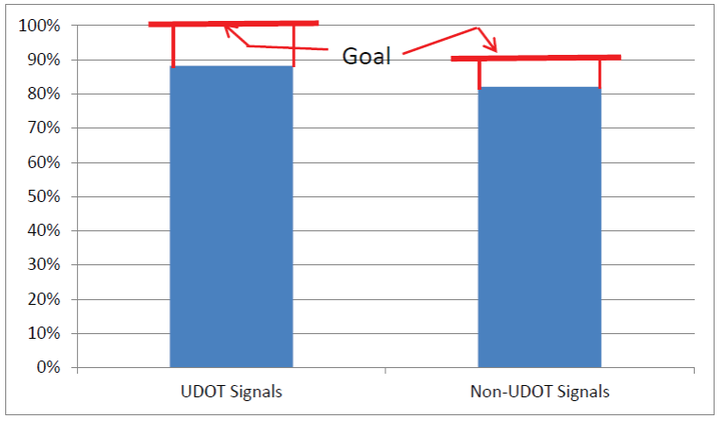

Figure 10 - Signal connected to ATMS

The traffic signal and ATMS systems rely on preventative maintenance plans for operational efficiency and reliability. The measures established for this objective are based on replacing equipment prior to failure and minimizing the number of emergency maintenance calls, exclusive of those associated with crashes and weather. Specific targets for these measures are in the process of being established for both the signal and ATMS systems.

Traffic signal devices connect to the ATMS system to create an efficient system to keep Utah moving. Currently 88% of the UDOT signals and 81% of non-UDOT signals are connected to the ATMS system. UDOT's goal is to connect 100% of UDOT signals and 90% of non-UDOT signals to the ATMS system.

Life-cycle Cost Analysis

Minimized Life-cycle Cost Strategy

Rather than a worst first approach to asset management, UDOT uses a more cost-effective approach based on life cycle cost management. The UDOT approach stresses asset preservation. Carefully timed preservation efforts help slow the deterioration and extend the life and value of roadway assets. As an asset's life span is extended, expensive replacement can be pushed further into the future. As a result, preventive maintenance and rehabilitation strategies can drive down the overall cost of ownership and maximize public funding.

UDOT's approach to life-cycle cost management varies significantly by asset type. Each approach is developed based on a combination of asset condition, value and risk.

- UDOT uses the asset value to set the level of management for each asset.
- The condition is determined by set performance measures and is used to determine annual financial need.
- Risk is used to prioritize funding available.

Asset Register

UDOT maintains registers of many assets through routine high-tech LiDAR scanning and maintenance inventories of the state highways. These registers are used to track the quantity and condition of each UDOT asset. UDOT also maintains an extensive database of current unit bid item costs compiled from the advertisement of new construction projects. This database is used to establish the replacement value of the quantified assets. Additional sources of information, such as R.S. Means, are referenced to establish a value for specialty items that are not in the database. A contingency amount is added to each asset value to account for design, construction oversight, traffic control, and mobilization costs.

The current quantified assets and their value are located in the following figures.

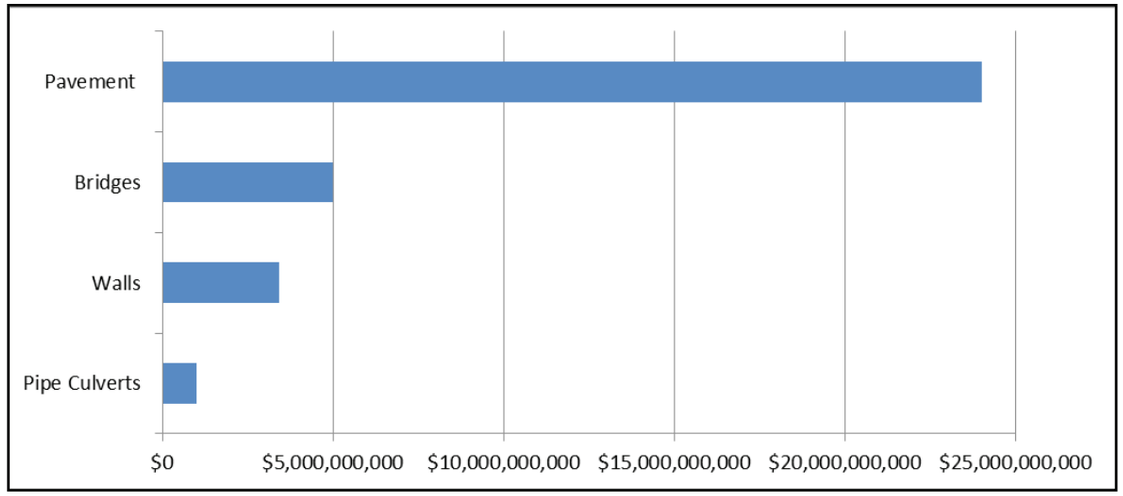

Figure 11 - Assets with value over $1B

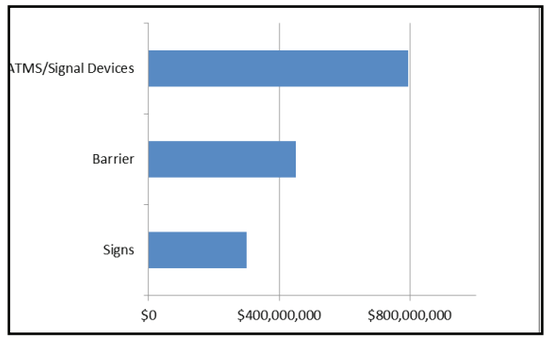

Figure 12 - Assets with value $800-$300 M

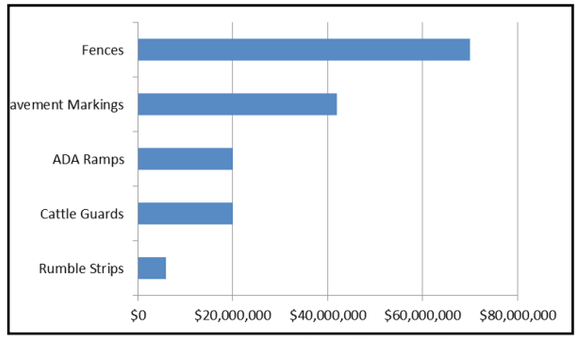

Figure 13 - Assets with value under $80M

The values shown are based on current costs to replace and construct/install the assets.

Life Cycle Models

The process for life-cycle analysis and management of UDOT's tier 1 assets is described below.

Pavement

Pavement is the highest value UDOT asset due to quantity and complexity. UDOT manages 16,000 lane miles across the state with a mature pavement management system and philosophy of "*good roads cost less*". This life cycle approach means timely, cost-effective treatments minimize long term cost while achieving the performance targets and maintaining pavement value.

UDOT has created a tiered system for prioritizing pavements in acknowledgment that current funding levels are not adequate to maintain the entire system at the same condition level. The tiers referred to as Functional Class are: Interstate, High volume (AADT greater than 1,000 and truck volume greater than 200), and Low volume (AADT less than 1,000). Additionally, roadways are divided into section for data collection and analysis. Each section has its own history including when it was originally constructed, traffic volumes, type of facility, biannual distress surveys, and

schedule of next preservation activity.

Biannually the Department's contractors measure the pavement health of each mile of the system. Starting in 2012 contractors driving at highway speeds, using state of the art technologies continuously measure each crack, the depth of each rut, roadway roughness, and concrete faulting. UDOT inputs this data into the Deighton Total Infrastructure Management System (dTIMS) software model. UDOT has used this model for many years to perform a life-cycle analysis of various treatment strategies on each of the 2,500 roadway sections. The benefit of the life-cycle strategy is balanced against the cost of the strategy (in net present value dollars). The result of this analysis is *"a plan for every section"*. The plans specify the preservation, rehabilitation and replacement strategies for each section over a period of years that will provide the highest overall benefit to the system condition within the available funding.

Table 2 illustrates examples of timed treatments for concrete and asphalt pavements. Timing of each treatment varies based on the bi-annual data collection and analysis. The timing and cost of treatments maintain pavements in perpetual "good" condition over a 50 year period.

Project recommendations from dTIMS are provided to UDOT's Region staff which then finalizes which projects to include in the recommendations to the Transportation Commission based on funding and other project priorities. Additional information regarding pavement can be found on the UDOT website in the Asset Management Home page.

Table 2 - Simulation of Life Cycle Costs

Surface Areas	Interstate	High Volume	Low Volume
Concrete, SY	2,600	925	
Asphalt, SY	5,400	11,135	4,510

Concrete Life Cycle Treatment				
Year	Treatment	$ / SY	Interstate	High Volume
10	Joint Seal, Spall & Crack Repair	$5	$123,552,000	$43,956,000
20	Joint Seal, Spall & Crack Repair, Slab Replace, Grind	$10	$247,104,000	$87,912,000
30	Joint Seal, Spall & Crack Repair, Slab Replacement	$8	$197,683,200	$70,329,600
40	Joint Seal, Spall & Crack Repair, Slab Replace, Grind	$10	$247,104,000	$87,912,000
50	Joint Seal, Spall & Crack Repair, Slab Replacement	$8	$197,683,200	$70,329,600
50 Year Total			$1,013,126,400	$360,439,200

Asphalt Life Cycle Treatment							
Year	Treatment	Interstate Unit Cost	High Volume Unit Cost	Low Voume Unit Cost	Interstate	High Volume	Low Volume
7	Crack Seal & Resurface	$12	$10	$5	$615,859,200	$ 1,058,270,400	$214,315,200
14	Crack Seal & Resurface	$12	$10	$5	$615,859,200	$ 1,058,270,400	$214,315,200
21	Structural Overlay	$25	$20	$15	$1,283,040,000	$ 2,116,540,800	$642,945,600
28	Crack Seal & Resurface	$12	$10	$5	$615,859,200	$ 1,058,270,400	$214,315,200
35	Crack Seal & Resurface	$12	$10	$5	$615,859,200	$ 1,058,270,400	$214,315,200
42	Structural Overlay	$25	$20	$15	$1,283,040,000	$ 2,116,540,800	$642,945,600
50	Crack Seal & Resurface	$12	$10	$5	$615,859,200	$ 1,058,270,400	$214,315,200
50 Year Total					$5,645,376,000	$ 9,524,433,600	$ 2,357,467,200
	TOTAL 50 Year Preservation				$6,658,502,400	$ 9,884,872,800	$ 2,357,467,200
	TOTAL 50 Year Preservation/Year				$133,170,048	$ 197,697,456	$ 47,149,344

Cost includes 25% for Traffic Control, Mobilization, Striping, etc. & 10% for Engineering

Bridges

An inventory of nearly 1900 bridges with a span of 20 feet or more across the state comprises UDOT's second largest value asset. UDOT uses the Bridge Management System (BMS) to manage the full inventory of bridges. The BMS is a collection of tools and a component of the asset management program that prioritizes projects based on the UDOT strategic direction, objectives, goals, and condition targets. The BMS includes an inventory and condition database, decision support software and additional tools for project prioritization and program development. The BMS assists UDOT, Structures Division and Transportation Commission by prioritizing projects in an approximate order of importance. Bridges are managed with a broad based business approach that links UDOT actions to the established measures and targets.

Data collection on bridges is extensive and always expanding, but primarily consists of three types of data:

- Information on the structure type, number of lanes, functional classification, and administrative items.
- History of the year/age for the last repair work completed and the last major rehabilitation for each structure.
- Physical condition data on the bridge.

Performance models predict the future condition of bridges and determine the appropriate treatment choice of preservation, rehabilitation, or replacement based on funding and condition. Recommendations are distributed to the UDOT Regions for inclusion in the construction project list. A joint workshop is held to finalize recommendations to be presented to the Transportation Commission that make final funding decisions.

ATMS and Signal Devices

Devices associated with UDOT's Automated Traffic Management System (ATMS) and Signal System make up the third tier 1 asset. These devices have a short life span relative to the pavement and bridge assets. This is due to rapid changes in technology and exposure of electronics to weather.

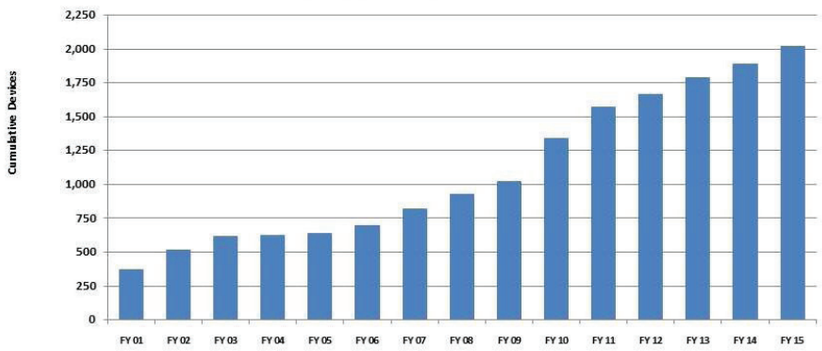

Figure 14 - Number of ATMS Devices

The fiber optic network and the number and types of ATMS devices has grown rapidly since they were first put in use in 2000. The devices installed during the early years of use are now over 10 years old and past their life expectancy. While some of the devices have been replaced as part of roadway construction projects; there are over 200 ATMS devices still in use that are over 10 years old. The Traffic Monitoring Stations, Variable Message Signs, and Roadway Weather Information System are part of this aging device list.

Figure 15 - ATMS/Signal Device Lifecycle Approach

UDOT is in the process of instituting a proactive, lifecycle approach to managing ATMS and Signal System devices. This approach requires a funding stream that includes device replacement at the expected end of life as well as initial purchase and installation costs.

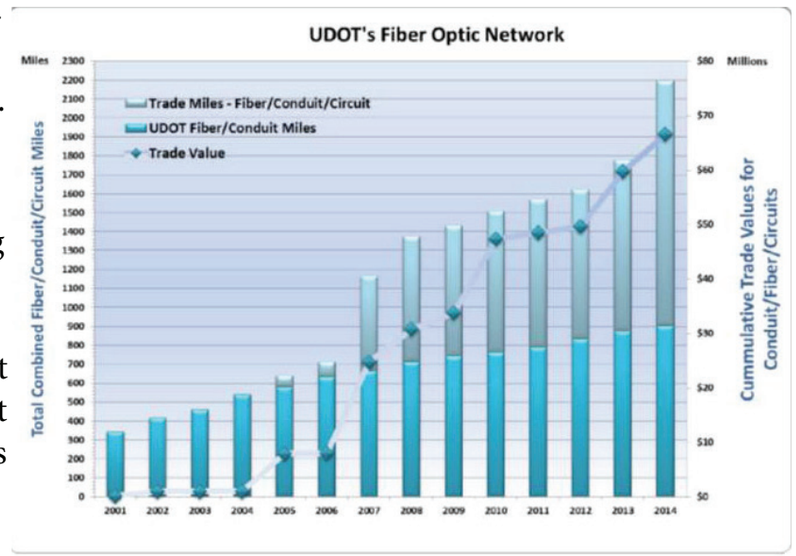

Figure 16 - Fiber Optic Network

Risk Management Analysis

UDOT has established three tiers of assets based on values and risks. This approach allows resources to be allocated to highest risk assets and risk areas. Pavement, bridges, and ATMS/Signal devices are tier 1 assets with values well above most tier 2 assets. These tier 1 assets also represent the greatest risks if managed poorly. UDOT has established management plans for these tier 1 assets which address all areas of risk.

Risk Identification and Assessment

In combination with the value each tier 1 and 2 asset is evaluated in four risk areas that were developed by the AAC:

- Financial – analysis of sustainable funding for performance goals
- Information – availability and quality of data needed for long term management
- Operational – analysis of probability and impact of asset failure to the operation of the transportation system
- Safety – analysis of impact to public safety of asset failure or poor condition

Risk is assessed for each asset in each of the four risk areas based on the probability of the risk happening and on the consequences. Probability and consequence are assessed separately as high, medium, or low and a risk number is assigned based on the risk matrix depicted:

Probability \ Consequences	L	M	H
H	4	7	9
M	2	5	8
L	1	3	6

Figure 17 – Risk Matrix

All four risk numbers are averaged for each asset with all four areas of risk being equally weighted. The management tier is assigned based on the average risk factor, the monetary value of the asset, and an assessment of the importance of the asset to UDOT's performance plan and strategic goals. Table 3 depicts the value and risk numbers for each tier 1 and 2 asset. The numbers are based on the risk matrix. Additional information regarding the financial value and risk assessment for each asset in each category of risk can be found in Appendix F.

Risk Mitigation Plan

As shown on Table 3, tier 1 assets have the highest operation risk and average risks. Performance-based management plans are well defined for these assets. History has proven these management plans minimize management costs and emergency repairs. All four categories of risk are monitored with bi-annual detailed inspection and data collection for pavements and bridges.

Tier 2 assets have average risks in the range of 5 to 2.5. Specific plans are in prog-

Table 3 - Risk Analysis for Tier 1 and 2 Assets

Asset	Financial Risk	Info. Risk	Operational Risk	Safety Risk	Average Risk	Value	Tier
Pavements	6	3	8	7	6	$24B	1
Bridges	6	3	8	8	6	$5B	1
ATMS/Signal Devices	6	6	5	5	5.5	$793M	1
Pipe Culverts	6	7	5	3	5	$1B	2
Signs	7	5	3	3	4.5	$300M	2
Walls	3	3	5	3	3.5	$3.4 B	2
Rumble Strips	3	4	2	5	3.5	$6M	2
ADA Ramps	2	2	1	5	2.5	$20M	2
Barrier	3	1	4	2	2.5	$450M	2
Pvt. Markings	2	1	2	5	2.5	$42M	2

* Value of inventoried pipe culverts only, urban area not included

ress to address the two tier 2 assets with average risk over 4 and any individual risk category greater than 5.

- Pipe culverts: Information risk is high due to lack of location and condition information. The culvert committee has established a prioritized list of data to be collected. They have also established a prioritized list of culvert locations. Each UDOT Region has been assigned the responsibility to obtain the top priority data on pipe culverts in the highest risk locations.
- Signs: Financial risk is high due to the substantial cost of replacing overhead signs and very limited funding currently allocated for sign replacement. The need for replacement of signs and associated structures are anticipated based on the federal requirement for increased lettering size and aging of signs. Sign location, size, and condition data has been collected and is now available in the GIS based data system. This allows signs to be included as project elements in the corridor and project planning phases.

Evaluation of Facilities

Pavements and bridges are inspected every two years as required by UDOT and FHWA policies. The results of these inspections are recorded in databases that maintain history of each pavement section and bridge that captures inspection results, repairs and reconstruction. This regular inspection process identifies repair and reconstruction needs that are incorporated into the Long Range Plan, State Transportation Improvement Plan, Maintenance Program and other relevant programs and plans. This proactive bi-annual process clearly identifies areas for repeated repairs and minimizes the need for emergency repairs by prioritizing needs and assigning them to the appropriate plan.

Financial Plan

The financial plan relies on the federal funding process, state annual budget process, and distribution decisions by the Transportation Commission. Funding available varies each year depending on the national and state economies and priorities of decision-makers.

Anticipated Funding Sources

UDOT operates its programs from a combination of federal, state and local funds. Amounts and percentages vary from year to year. Figure 18 includes income percentages from fiscal year 2015.

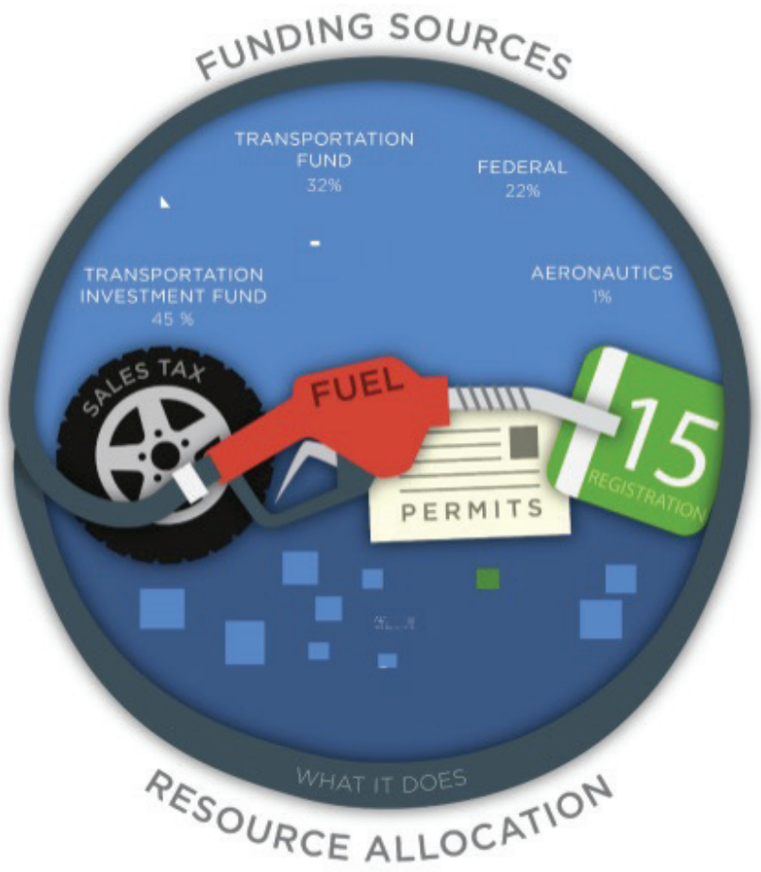

Figure 18 – 2015 Funding Sources

Figure 19 depicts anticipated percentages from each funding source for FY 2016.

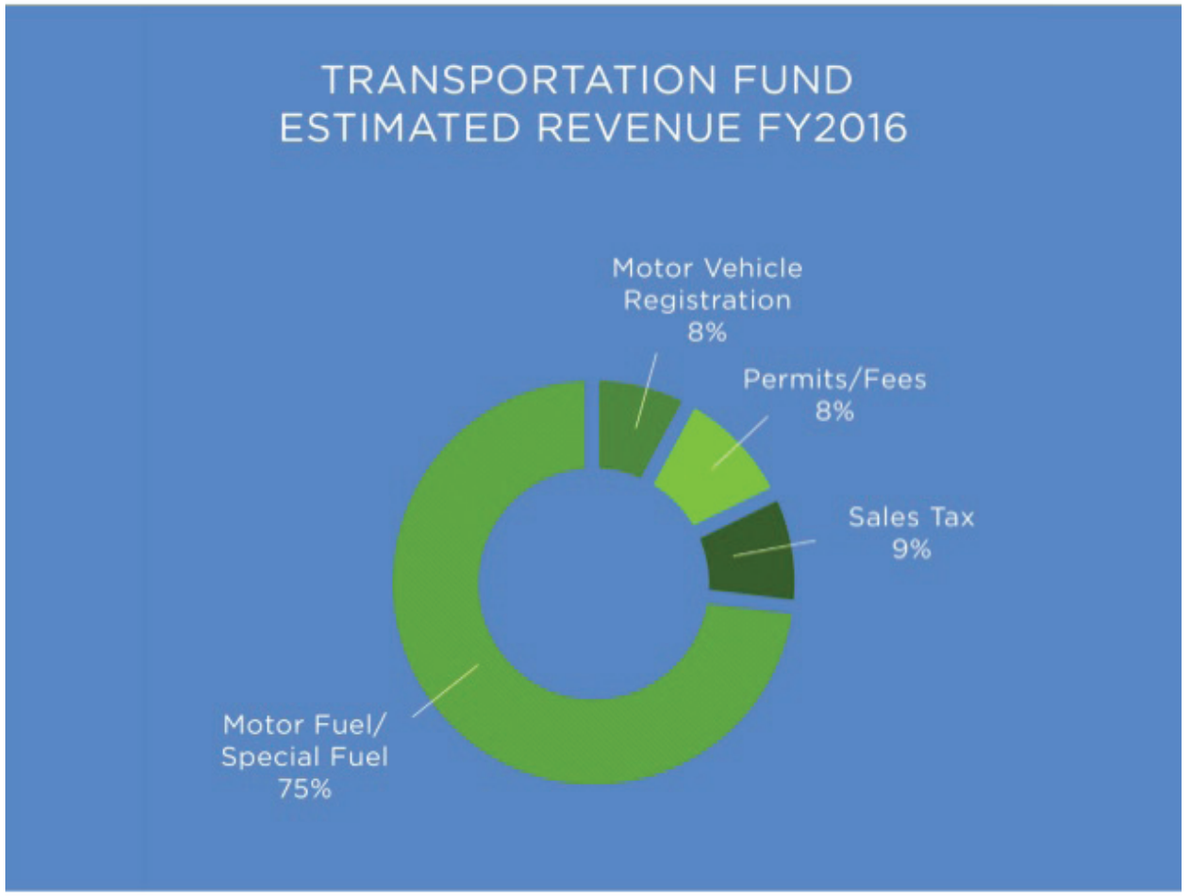

Figure 19 - 2016 Funding Sources

Projected Funding Levels

UDOT, in cooperation with the state's Metropolitan Planning Organizations and Utah Transit Authority compile a Unified Transportation Plan that summarizes major capacity improvements to meet the projected travel demand and also identifies maintenance, preservation and operating needs of existing and newly built infrastructure through 2040. The Plan identified a need for a combination of future increases of existing revenue sources and implementation of new revenue sources. Some specific strategies assumed for revenue sources are included in the plan and will likely vary at the discretion of Utah's state and local elected officials. Specific assumptions include:

- Increase statewide fuel tax or equivalent
- Increase statewide vehicle registration fee
- Add local-option taxes

More details of projected costs and funding sources can be found in the Utah Unified Transportation Plan 2011-2040 on the UDOT website .

Asset Value Sustainability

UDOT has established sustainability targets for pavements and bridges as required by MAP-21. Targets for ATMS/Signal devices have also been established. Funding needs and strategies are different for each of these assets and are included in this section.

Estimated Asset Values

Table 4 depicts the replacement value of UDOT assets. This value is based on current construction costs and includes an amount for design, construction oversight, traffic control, and mobilization.

Table 4 - Asset Values

Asset Type	Quantity	Value
Rumble Strips	26,287,969 FT	$6,000,000
Cattle Guards	895 Each	$20,000,000
ADA Ramps	14,779 Each	$20,000,000
Pavement Markings	26,000 Miles	$42,000,000
Fences	1,890 Miles	$70,000,000
Signs	96,160 Each	$300,000,000
Barrier	7,347,574 FT	$450,000,000
ATMS/Signal Devices	Lump	$793,000,000
Pipe Culverts	16,553 Each	$1,000,000,000
Walls	71,820,494 SF	$3,400,000,000
Bridges	19,515,339 SF	$5,000,000,000
Pavement	172,045,914 SY	$24,000,000,000

Estimated Annual Costs

Pavement

UDOT has set sustainability targets to maintain UDOT pavements within acceptable condition levels that meet or exceed national, state, and UDOT goals. UDOT uses dTIMS and the data from Operations Management System (OMS) to predict future pavement condition for Interstate, NHS, High Volume and Low Volume pavements. The following figures illustrate predicted pavement conditions based on anticipated funding over a ten year time frame.

Interstate pavements

Over the past several years interstate pavement condition targets have been exceeded. Therefore funding for interstate pavements will be reduced to maintain interstate pavements within set targets.

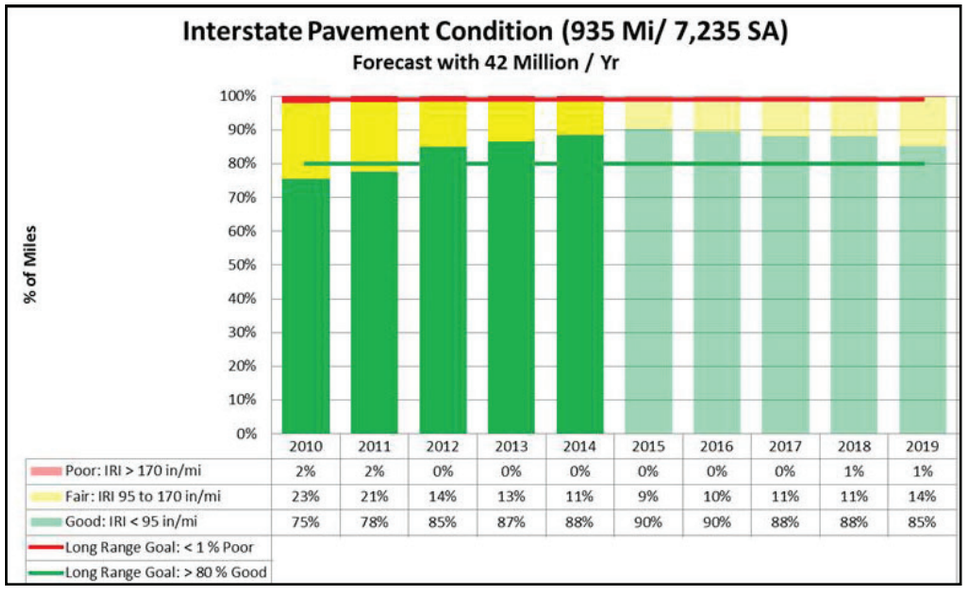

Figure 20 - Interstate Pavement Condition Forecast

NHS Pavements

The estimated cost to maintain NHS pavements at the target condition over a ten year period is $80 million per year. This estimate is based on the dTIMS model using current pavement condition data. Figure 21 depicts the condition forecast of NHS pavements statewide.

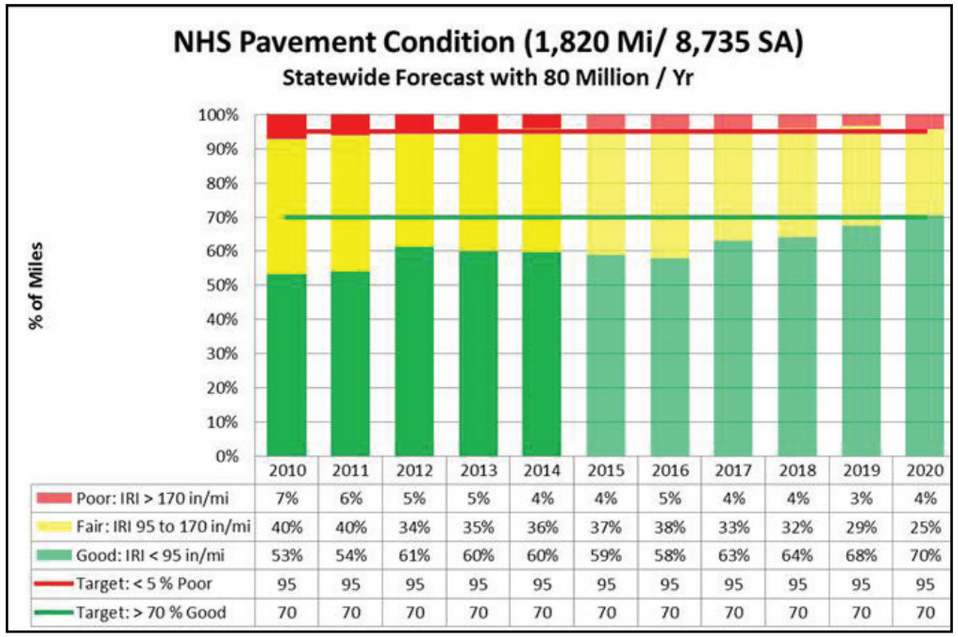

Figure 21 - NHS Pavement Condition Forecast

High Volume Pavements

The estimated cost to improve High Volume pavements to the target condition over a ten year period is $46 million per year. This estimate is based on the dTIMS model using current pavement condition data. Figure 22 depicts the condition forecast of High Volume pavements statewide.

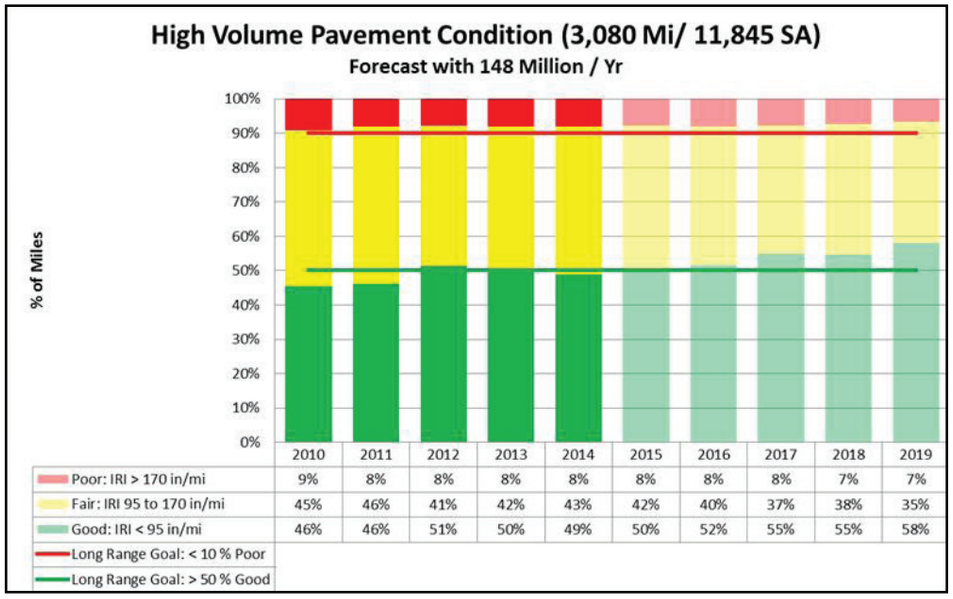

Figure 22 - High Volume Pavement Condition Forecast

Low Volume Pavements

The current level of investment in Low Volume roadways has resulted in the percentage of pavement in good condition gradually declining. Therefore funding levels have been increased and the resulting predicted gradual increase in pavement

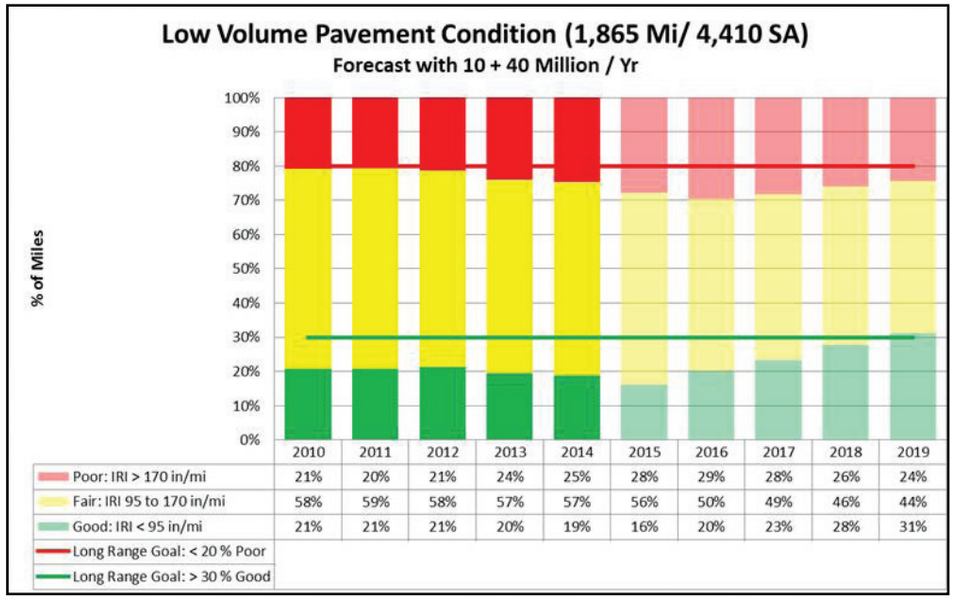

Figure 23 - Low Volume Pavement Condition Forecast

condition is depicted in Figure 23.

Bridges

Structures are prioritized for rehabilitation and replacement based on vulnerability and criticality. Vulnerability measures the physical condition and load carrying capacity. The physical condition of the structure is captured by the Bridge Health Index and the load carrying capacity is defined by the operating load rating. Criticality is determined by measuring three distinct parameters: AADT, bypass length, and bridge length. More information on bridge program prioritization process can be found in the Bridge Management Manual.

Predicted condition based on current funding resulted in UDOT falling below condition targets set for the NHS, State System, and the Local Federal Aid System, therefore, the legislature approved increased funding. The following figures depict forecasted bridge condition based on funding levels for each system.

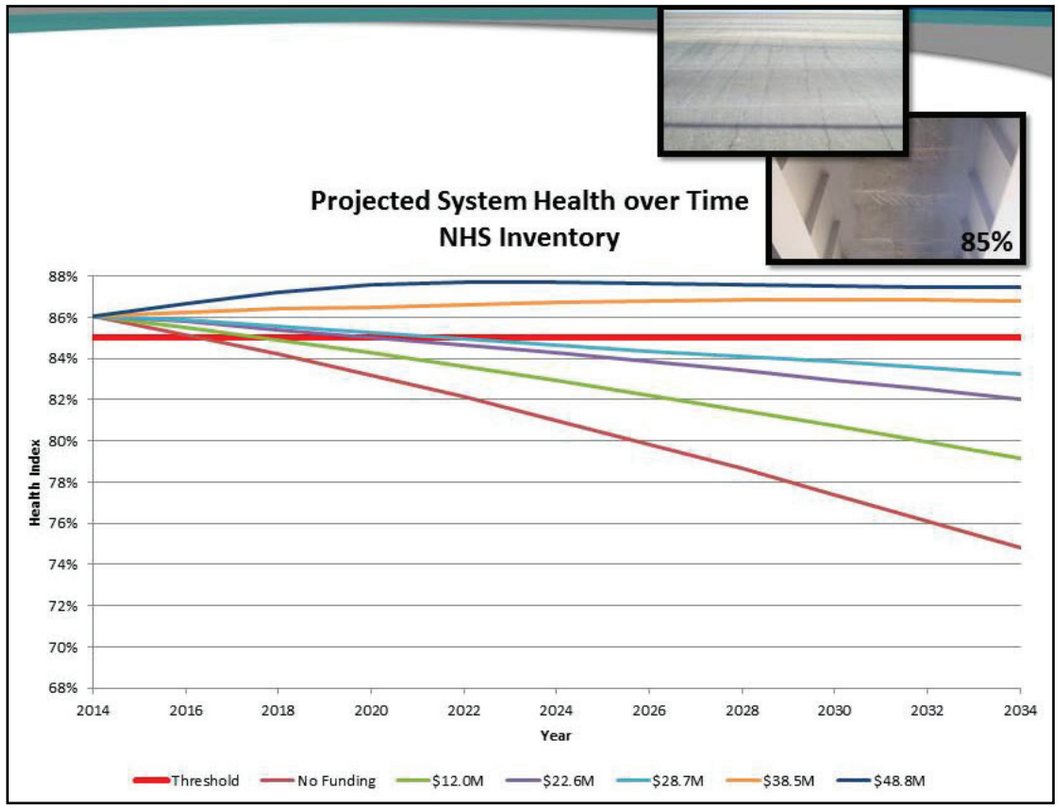

Figure 24 - Forecast Conditions for NHS Bridges

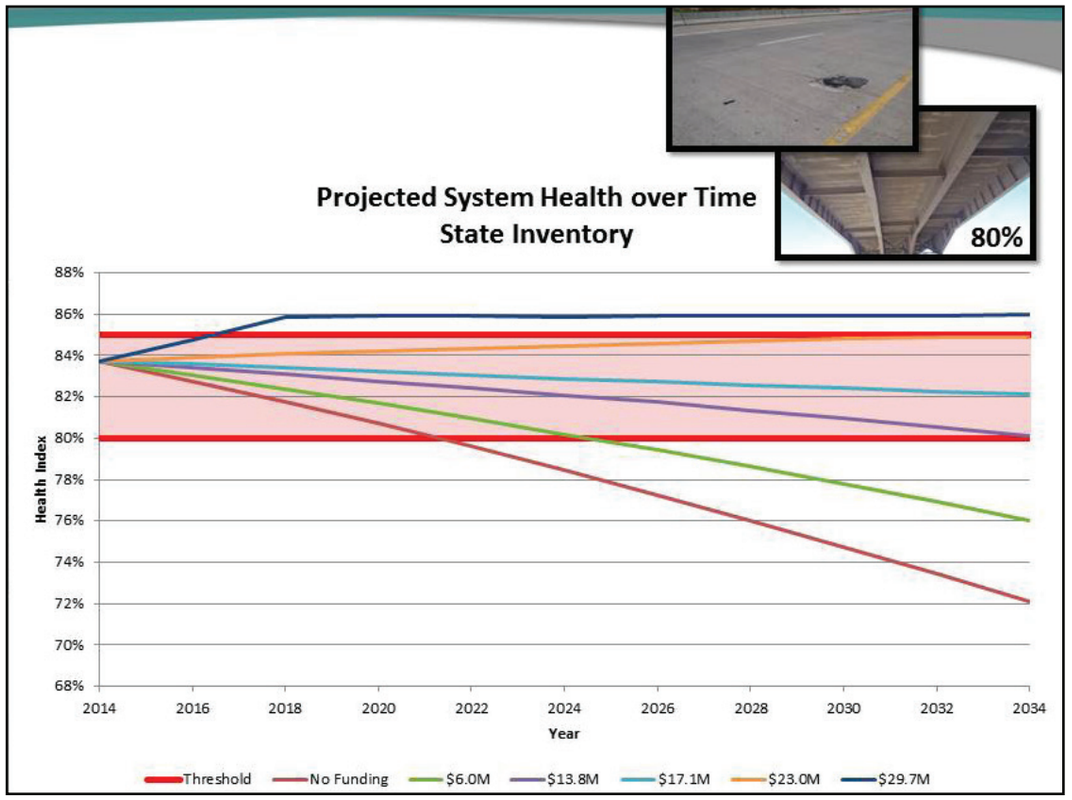

Figure 25 - Forecast Conditions for State Bridges

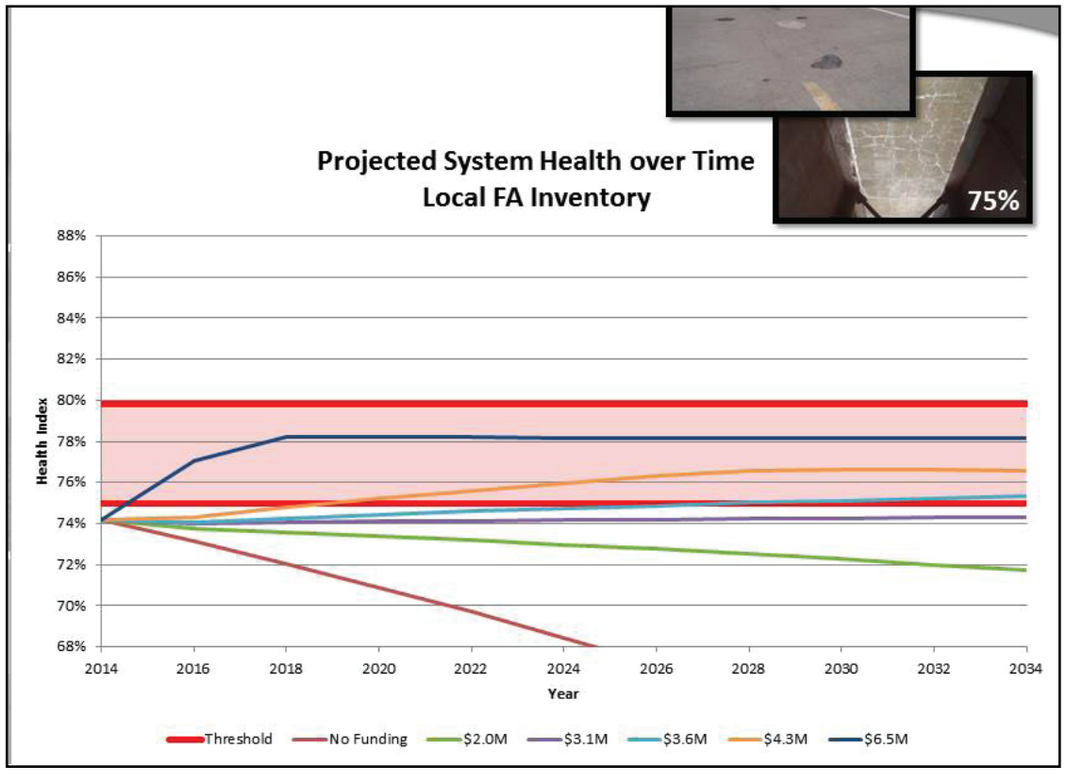

Figure 26 - Forecast Conditions for Local FA Bridges

ATMS/Signal Devices

UDOT is adopting a complete lifecycle approach to ATMS device management to achieve system reliability. This approach includes the orderly disposition of devices at end-of-life. At the end-of-life each device will be formally evaluated to determine if the device is replaced in kind, upgraded, or decommissioned as no longer needed.

The end of life estimates are based on a combination of national experience, manufacturer recommendations, and UDOT experience with each specific device.

Device Type	Addressed in Constr.	Backlog < 2017	2017	2018	2019	2020	2021
Variable Message Signs	4	21	34	8	11	6	0
Traffic Management System	17	0	19	90	43	79	27
Closed Circuit Television Camera	14	0	1	154	1	113	198
Express Lanes	18	105	24	0	18	37	0
Road Weather Information Systems	0	0	53	26	58	117	90
Communications Switches	33	18	1	541	0	246	0
Communication Junction Boxes	0	1000	0	0	0	0	0
Transformer	6	**0**	**0**	**0**	321	**0**	**0**

Figure 27 - End-of-Life Estimates

A five year plan is being put in place to replace devices which have already reached end-of-life or are expected to within the five year plan time frame. Timing of replacement is based on a combination of ease of replacement and consequence of failure.

- Ease of replacement example – CCTV can fail because it can be replaced quickly (within 1 week), compared to a VMS which can take a few months to replace.
- Consequence of failure example – allowing a hub to fail would impact a large number of devices, therefore creating a large negative consequence and indicating they should be replaced prior to failure.

Funding for this lifecycle approach is not currently in place. A funding plan has been developed that replaces devices which have already reached end-of-life over the next three years and includes an equal amount for each of five years to replace the remaining devices. This plan lessens the impact of the new funding request.

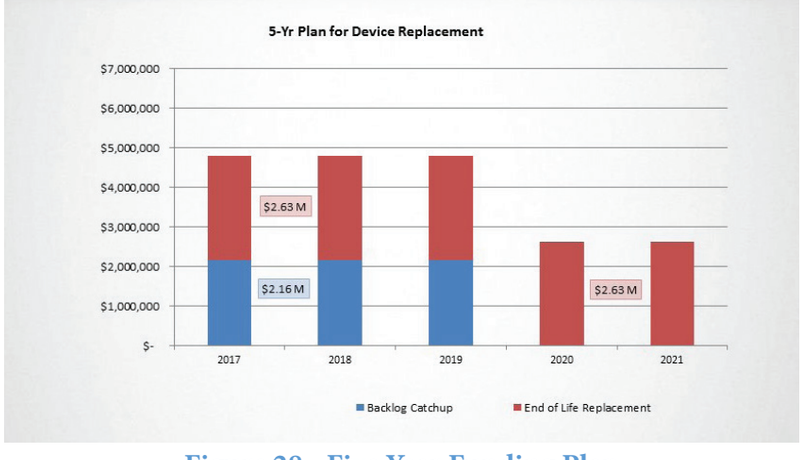

Figure 28 - Five Year Funding Plan

Investment Strategies

Preservation of NHS Performance

UDOT has an established history of combining funding sources to develop projects and programs that:

- Achieve and sustain a desired state of good repair
- Improve or preserve the condition of the assets and the performance of NHS
- Make progress toward achievement of state targets for asset condition
- Support progress toward achievement of national goals

This investment strategy has resulted in Interstate and NHS pavements and bridges maintained within or above state and national targets for condition, public safety, and system mobility. Combining fund sources maximizes the extent each dollar preserves NHS performance.

Influence of Analyses

Performance gap analysis

The performance gap analysis identified processes and tools that UDOT can sharpen and modify to deepen alignment of existing programs, organize data and make it more accessible, and measure asset performance. The five year roadmap that resulted from the gap analysis increases the efficiency with which UDOT supports achievement of state and national goals. The roadmap also develops a greater collaboration among those responsible for all transportation needs.

Life-cycle cost analysis

IN 2012 UDOT initiated a program of automated data collection across divisions. This biennial effort and the ability to access the data through UGate, a centralized collection of data in GIS format, was a key to the development of a value matrix for roadway assets. Understanding the value of each asset led UDOT to establish a three tier asset system. Pavements represent over 2/3rds of UDOT's asset value and have historically been managed by life cycle costs and predictive modelling. The philosophy of "good roads cost less" is a life cycle cost approach that minimizes long term costs of achieving performance targets and maintaining asset value. A similar approach has been adopted by the Structures Division and is in the process of implementation.

Risk management analysis

Risk identification and assessment is a relatively recent addition to UDOT's toolbox. The analysis of probability and consequences allows further refining of prioritizing projects and programs that maintain or improve overall system performance.

Anticipated available funding

UDOT, in cooperation with the state's Metropolitan Planning Organizations and Utah Transit Authority compile a Unified Transportation Plan that summarizes major capacity improvements to meet the projected travel demand and also identifies maintenance, preservation and operating needs of existing and newly built infrastructure through 2040. The current Unified Plan identifies a need for a combination of future increases of existing revenue sources and implementation of new revenue sources. At current funding levels, pavement and bridge preservation will meet state and national targets. UDOT will continue to work closely with other agencies and elected officials to ensure funding levels and sources will preserve existing assets as well as meet the transportation demands of a growing population.

APPENDIXES

Appendix A - Asset Management Oversight Structure

To address Utah's infrastructure challenges and embrace opportunities, this TAMP updates the Asset Management Strategic Plan that has been in place since 2001. The updated version includes redefining the structure for asset management that oversees the program funding and implementation of the strategic plan. The purpose of the oversight structure is to provide recommendations to the Transportation Commission for approval that maximize system performance and funding. The structure creates new cross-sectional collaboration between traditionally separate functions of planning, design, construction, maintenance, traffic, and information technology. Collaboration will result in unified program recommendations based on a transparent, data-driven decision-making process. The oversight structure will assist UDOT in careful management of each asset throughout each phase of the asset's life by utilizing program alignment, organized and accessible data, and risk-based asset performance.

Asset Management Steering Council

The Transportation Systems Management Team (TRANSMAT) has been reformed and renamed the Asset Management Steering Council (AMSC). The reformed AMSC is chaired by the Deputy Director and consists of eight members.

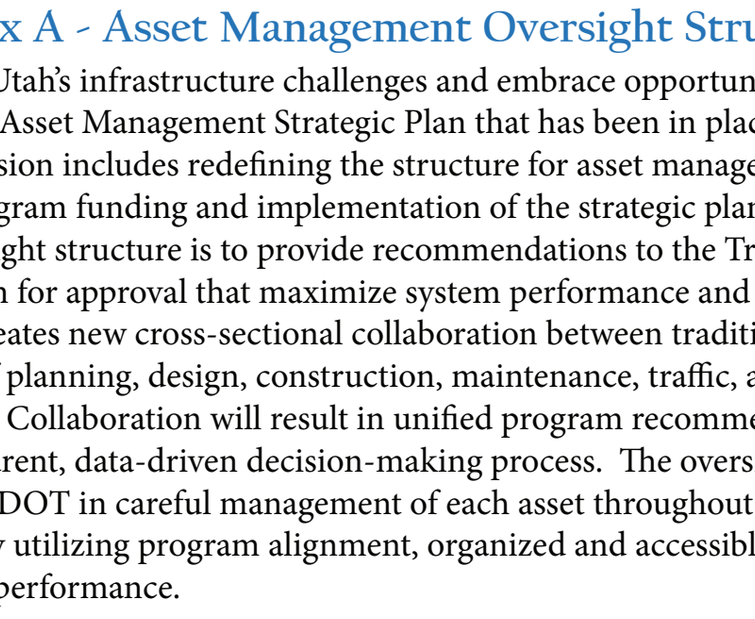

Figure 29 - AMSC Membership

Specific objectives to include:

- Ensuring horizontal and vertical communication and integration across the organization relative to asset management,
- Providing direction and approving effective policies, programs, and processes, to ensure ongoing improvement of asset management,
- Evaluating the direction of asset management annually, and
- Reporting the results of UDOT's Transportation Program measurements.

Asset Advisory Committee

The Asset Advisory Committee (AAC) has been formed to enhance the communication flow between the strategic work of the AMSC and the "boots on the ground" technical experts. This committee will implement strategies in a coordinated manner to continually improve the asset management process. The AAC is chaired by the Asset Management Director and consists of designated division leaders.

Figure 30 - AAC Membership

Specific objectives of the AAC include:

- Recommending modifications to policies and processes to improve asset management practices to the AMSC,
- Working together across department boundaries to develop and recommend a unified program to the AMSC that maximizes system performance and funding, and
- Aligning programs to determine the most cost effective method of addressing asset needs.

The enhanced collaboration across functions is expected to lead to synergistic improvements for individual asset performance beyond the level that any one division could achieve. UDOT has shown great success due to collaboration while preparing for the 2002 Olympics, embracing Design/Build and other alternative contracting methods, initiating the use of Accelerated Bridge Construction (ABC), etc. This committee organization engages UDOT leaders to make strategic decisions and also informs and educates employees throughout UDOT regarding the direction of asset management and their critical involvement.

Policy 07-13

Asset Management Oversight Structure **UDOT 07-13**

Effective: Revised: June 30, 2014

Purpose

To outline the responsibilities of the Utah Department of Transportation (Department) Asset Management Steering Council (AMSC) and the Asset Advisory Committee (AAC). These responsibilities include providing recommendations to the Transportation Commission pertaining to planning, developing, and preserving the investment in Utah's Transportation System and obtaining maximum cost effectiveness from transportation construction, rehabilitation, and maintenance programs. AMSC and AAC activities support the Department strategic goals:

1. Preserve Infrastructure
2. Optimize Mobility
3. Zero Fatalities
4. Strengthen the Economy

Policy

The AMSC and AAC provide recommendations to preserve the large investment in the State's roadway and transportation systems and provide a strategy to obtain an enhanced system of highways and related transportation modes that continue to meet the needs of Transportation System users. The teams assist the Department in obtaining cost effective solutions for system needs by using program alignment, organized and accessible data, and risk-based asset performance. The council and committee make sure all divisions of the Department are working together to present a unified program recommendation based on a transparent decision-making process.

ASSET MANAGEMENT STEERING COUNCIL MEMBERS

Deputy Director – Chair
Program Development Director
Project Development Director
Operations Engineer
Region 1 Director
Region 2 Director
Region 3 Director
Region 4 Director
Asset Management Director (Secretary)
FHWA Division Administrator or designee

ASSET ADVISORY COMMITTEE MEMBERS

Asset Management Director – Chair
Planning Director
Traffic Management Engineer
Traffic and Safety Engineer
Engineering Services Director
Structures Chief Engineer
Maintenance Director
Region 1 Representative
Region 2 Representative
Region 3 Representative
Region 4 Representative
FHWA Team Leader or designee

Various divisions, sections, and regions provide needed staff support and input to AMSC. AAC members may be invited to participate in AMSC meetings at the chairman's discretion. AMSC is authorized to establish pro tem teams and task forces to assist in accomplishing its responsibilities.

AMSC will consider strategic level Transportation Systems Management activities within the Department; make recommendations to the Transportation Commission; improve efficiency of the decision making process; and assure consistent transportation systems management practices at all supervisory levels.

Specific responsibilities of the AMSC include:

1. Recommending Department transportation strategies to the Transportation Commission to implement and achieve the Department transportation policies.

2. Recommending policies and resource levels that support ongoing improvement of asset management and a unified transportation program.

3. Guaranteeing horizontal and vertical communication and integration across the Department relative to asset management.

4. Reviewing and reporting the results of the Department's Annual Transportation Program to the Transportation Commission and public.

5. Evaluating the direction of asset management annually in a joint meeting with AAC.

AAC oversees implementation of the Department's Transportation Systems Management Process.

Specific responsibilities of the AAC include:

1. Recommending to the AMSC modifications to policies and processes to improve asset management practices.

2. Working together across department boundaries to develop and recommend a unified program to the AMSC that maximizes system performance and funding.

3. Aligning programs to determine the most cost effective way of addressing asset needs.

4. Determining the appropriate management level for each asset.

Definitions

A Transportation Systems Management Process provides a set of various tools or methods to assist decision makers in finding optimum strategies for providing and maintaining the transportation systems in an acceptable condition over a planned period. The process includes analysis programs and related data to include but not limited to the following transportation areas: Pavements, Safety, Structures, Mobility, Design, Construction, Maintenance, and Planning.

Appendix B - Gap Analysis Process and Results

In order to begin the process of evaluating the current situation of Asset Management, the *Asset Management Implementation Plan* (developed in June 2004 and updated in April 2006) was reviewed. It was noted that many of the actions identified in the plan had been achieved, and UDOT has had great success in regards to managing assets especially bridges and pavements. The document also identified that many of the divisions within UDOT were working towards the goals set forth as a strategic direction by senior leaders at the time. Over the past 8 years, there have been great technological advances and some change in direction in the strategic plan. These events have created new challenges and opportunities that are addressed in this TAMP.

In order to identify the steps taken to raise asset management to a gold standard, self-assessments were completed. The assessments results were identified through a process of brainstorming sessions, surveys, and interviews specific to divisions.

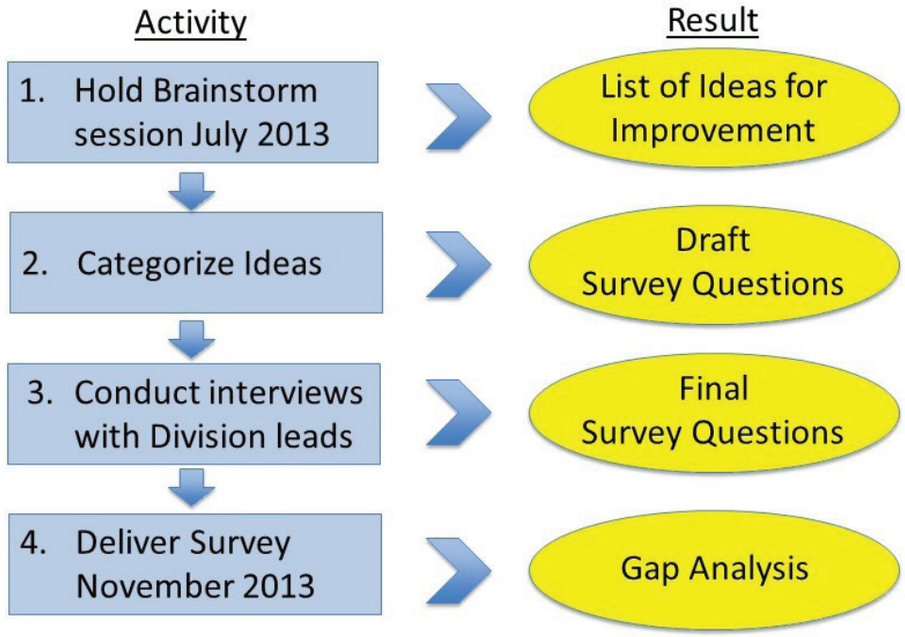

Figure 31 - Gap Analysis Flow Chart

Self-Assessment and Gap Analysis

Specific activities were taken to understand the gaps associated with Asset Management as shown in Figure 31 and described below.

- Activity 1. The asset Management Steering Council participated in a facilitated discussion of the purpose of a five year strategic plan and issues currently faced by council members. This discussion in July 2013 resulted in a collection

of comments and questions written on pot-it-notes by voting and non-voting council members

- Activity 2. The discussion facilitators, RiversQuest Consulting and V-I-A Consulting, organized the comments and questions from the July meeting into major categories. The results of the categorization are shown in Figure 32. The percentages presented are based on 79 total post-it notes collected. The actual comments are included in Appendix C.

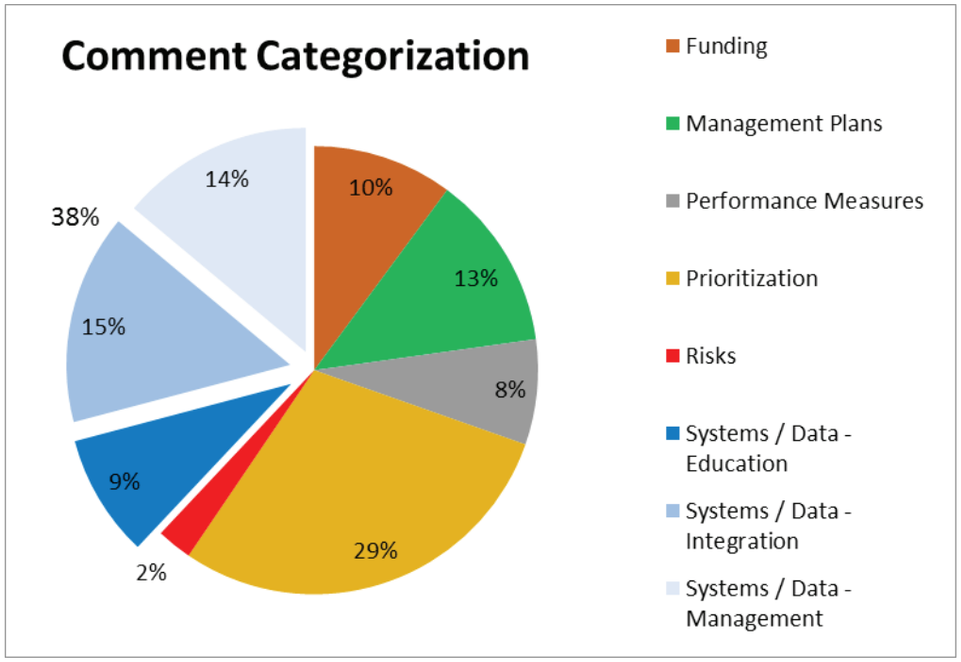

Figure 32 - Comment Categorization

- Activity 3. Questions were developed from the comments gathered in Activity 1 and incorporated into a Gap Analysis Survey. The initial questions were fine-tuned and minimized based on individual discussions with senior UDOT leaders.
- Activity 4. Eleven questions were presented to the TRANSMAT Committee during the November 2013 meeting (See Appendix C). Each statement was rated in two ways.

  1. The statement was rated on level of importance to the UDOT program on a scale of 1-5. The scale was defined as 1-very important to 5-unimportant.
  2. Next each statement was rated on a scale of 1-5 relative to UDOT's current level of performance with 1-excellent and 5-poor.

  Twenty-three meeting participants recorded their answers with a handheld device and results which were immediately available for each statement.

The meeting facilitators analyzed the results and incorporated the information into a report for consideration. Senior leaders elected to reorganize TRANSMAT into the Asset Management Organization Structure noted above.

Gap Analysis Results

The gap between the importance of each statement and the current status of UDOT performance as rated by the TRANSMAT Committee members is depicted in Figure 33. Appendix D contains the details of the voting results. The results show the biggest gaps are in areas related to information technology. As technology rapidly advances much more data is gathered and the challenge comes in gathering the knowledge from each function and making it available to others. Information systems support a coordinated, seamless approach to Asset Management.

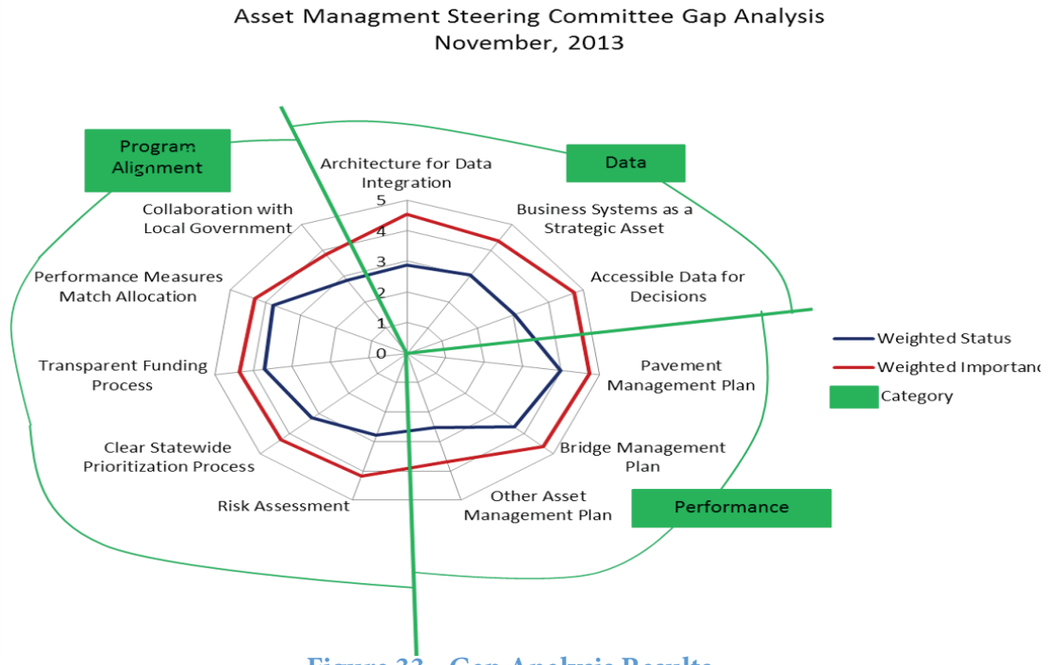

Figure 33 - Gap Analysis Results

Further discussion of the gap analysis results led to the identification of three major areas of focus.

- The three questions related to data show the largest gaps and the highest importance of all the questions. These questions focus on the organization and accessibility of data for business systems across UDOT.
- Three questions related to asset performance and identified a need to focus on performance measures and different levels of management plans for assets.
- The remaining questions relate to aligning programs within UDOT and with partners to ensure transparent and data driven decision processes are in place to build and maintain public trust.

These major areas of focus became objectives for the five year plan and led to defining the asset management goal.

Appendix C - Committee Comments, July 2013

TRANSMAT Committee Comments Regarding Asset Management Plan

Comment Provided By	Ideas	Responsibility	Category
Non-Voting Member	This group determines how well funding is set / prioritized	Steering Committee	Funding
Non-Voting Member	We should improve how we sweep the corners for money left on projects	Steering Committee	Funding
Non-Voting Member	What can be done to maximize the use of the public's money? If we recapture money more quickly does that help?	Steering Committee	Funding
Non-Voting Member	Need: Enhance the ability to quickly evaluate program balances and delivery	Steering Committee	Funding
Non-Voting Member	Need: to define what is intended in fund types that Transmat approves. Agree to update "Fund Fact Sheets" yearly.	Steering Committee	Funding
Non-Voting Member	Need: To consider Active Transportation Policy in funding decisions.	Steering Committee	Funding
Voting Member	Definition documentation for funding types and processes. Basically setting the rules for when funds can be used, combined, etc. When does it require Commission action?	Steering Committee	Funding
Non-Voting Member	Need: To identify what can be spent on bridges using Purple and Orange Book projects if it is allowed.	Structures	Funding
Voting Member	Life cycle replacement plan for ATMS / Signal systems	T&S	Management Plan - Other
Non-Voting Member	Need to put culverts in our program. Need to track them and see where we are at	Asset Management	Management Plans - Other
Non-Voting Member	Capacity is an asset. Public trust is an asset. How can we manage these non-tangible assets?	Steering Committee	Management Plans - Other
FHWA	Is congestion or capacity throughout a tangible asset? (Time to get to work, speed, volume, ridership)	T&S	Management Plans - Other
Non-Voting Member	Mobility is an asset. How do we manage?	T&S	Management Plans - Other
Non-Voting Member	We should consider safety, choke, Pt, capacity as an asset	T&S	Management Plans - Other
Non-Voting Member	Need to show target level for concrete pavements. Big dollars coming at UDOT for older sections.	Asset Management	Management Plans - Pavements
Non-Voting Member	Bridge: We need a plan for every structure on every road	Structures	Management Plans - Structures
Non-Voting Member	Bridge: Define / plan for off system bridge, develop a strategy, preservation, funding	Structures	Management Plans - Structures
Non-Voting Member	Need: A plan for every bridge	Structures	Management Plans - Structures
FHWA	Have you checked out the FHWA's INVEST tool to examine a projects sustainability of the sustainability of our planning process?	Planning	Performance Measures
Non-Voting Member	Need: to establish asset performance measures with FHWA so UDOT isn't reporting by project then we can deliver project by asset needs instead of project specific inventories.	Steering Committee	Performance Measures
Non-Voting Member	Need: Quarterly reports on each asset and accomplishment.	Steering Committee	Performance Measures
Non-Voting Member	How do we measure success in asset management? Do these measure change by asset type? What impact does design, concept, development have on asset management	Steering Committee	Performance Measures
Non-Voting Member	ATMS devices need performance standards	T&S	Performance Measures
Non-Voting Member	Safety: How do we measure performance?	T&S	Performance Measures
Voting Member	Plan for every road: Cost/Benefit ratio should be calculated to see if it's worth it to develop a plan.	Asset Management	Prioritization
Voting Member	Develop asset priority list	Asset Management	Prioritization
Voting Member	Develop a process and prioritize our assets for analysis and recommendation	Asset Management	Prioritization
Voting Member	Due to constraints, we should evaluate those assets of highest value and cover those of greatest need. Can't do them all.	Asset Management	Prioritization
Voting Member	Different levels of asset management are available – we need to identify what level is needed for each asset – maybe B/C?	Asset Management	Prioritization
Non-Voting Member	Need: to move to Statewide Prioritization Process based on strategic goal (UDOT and MAG Process).	Planning	Prioritization
Voting Member	Project Delivery – Implications of TRANSMAT decisions should be considered	Project Delivery	Prioritization

Comment Provided By	Ideas	Responsibility	Category
Non-Voting Member	Communicating the prioritization process	Steering Committee	Prioritization
Non-Voting Member	What added methods can be used to prioritize other assets and projects types? Where are we on financial cross asset management? How to value work on asset to another, comparing apples to oranges.	Steering Committee	Prioritization
Non-Voting Member	Define assets to be managed, Rank Assets	Steering Committee	Prioritization
Non-Voting Member	Use Engineer / Business Decision for maintaining assets	Steering Committee	Prioritization
Non-Voting Member	Asset prioritization – which assets should we focus on first? What can we afford to do now?	Steering Committee	Prioritization
Non-Voting Member	Improve how recommendations are made to Commission progress / process	Steering Committee	Prioritization
Non-Voting Member	We need 3 year program by region to do the right project at the right time	Steering Committee	Prioritization
Non-Voting Member	Are there best practices defined that can help guide our program?	Steering Committee	Prioritization
Voting Member	Use data to rank projects (based on need)	Steering Committee	Prioritization
Non-Voting Member	Safety: How do we measure working with other projects (bridge, pavement)	T&S	Prioritization
Non-Voting Member	Choke Pt projects make it data derived not even distribution	T&S	Prioritization
Non-Voting Member	Need: Three year plan for safety projects	T&S	Prioritization
Non-Voting Member	When balancing project cost against minimal decrease in safety, how is minimal defined? What is an acceptable decrease & how do you quantify cost to safety?	T&S	Prioritization
Non-Voting Member	Safety: Identify how we prioritize safety projects	T&S	Prioritization
Voting Member	Use crash data to prioritize safety projects	T&S	Prioritization
Non-Voting Member	Continue down the path of sign replacement. More reflective not necessarily changing the sign bridges. (Not as critical as culverts)	Asset Management	Prioritization

Comment Provided By	Ideas	Responsibility	Category
Voting Member	Incorporate risk analysis into asset management processes	Asset Management	Risks
Voting Member	Better define our risk analysis / factors	Project Delivery	Risks
Non-Voting Member	What is the program for minor rehab and preservation? Where can it be found? Does it state the treatment type?	Asset Management	Systems/Data - Education
Non-Voting Member	UPlan is the tool to Use!!! One stop shop = Efficiency	Steering Committee	Systems/Data - Education
Non-Voting Member	Employees need education and training on UPlan and UGate	Steering Committee	Systems/Data - Education
Non-Voting Member	Communication	Steering Committee	Systems/Data - Education
Non-Voting Member	Low trust in the data in UPlan and UGate. Need to know the source of the data.	Steering Committee	Systems/Data - Education
Voting Member	We need to educate stakeholders about assets data and UPlan	Steering Committee	Systems/Data - Education
Voting Member	Educate department on what data is available. Consolidate and build systems to make it readily available.	Steering Committee	Systems/Data - Education
Non-Voting Member	What level of integration is enough to feed asset management?	Asset Management	Systems/Data - Integration
Non-Voting Member	We do a good job with pavement and fund allocation but the data and allocation is about 2 years behind. Example: Core project has made pavement good in Utah County but won't see funding levels change for 2 to 3 years. Can we get data change faster?	IT	Systems/Data - Integration
Non-Voting Member	Need data collection that is recent and relevant IE: Traffic data needs to be newer then 3 years old	IT	Systems/Data - Integration
Voting Member	Continue building business systems that share and integrate data	IT	Systems/Data - Integration
Non-Voting Member	The TMD has data that other groups / regions need to make better decisions	Planning	Systems/Data - Integration

Comment Provided By	Ideas	Responsibility	Category
Non-Voting Member	What do we know about our current assets? How can big data help us drive asset decisions?	IT	Systems/Data - Integration
Non-Voting Member	Need: Widen data collection by gathering other data from stakeholders (InRix, Freight, Events)	IT	Systems / Data - Integration
Non-Voting Member	Bridge: Can we begin showing bridge data on UPlan / UGate	Structures	Systems / Data - Integration
Non-Voting Member	Do we have enough data to do asset analysis? Deterioration process? Current condition? Last modification?	Asset Management	Systems / Data - Management
Non-Voting Member	Would better systems improve our ability to manage our assets?	Asset Management	Systems / Data - Management
Voting Member	Collect data for additional assets	Asset Management	Systems / Data - Management
Non-Voting Member	Our systems are assets we need to manage and some of our systems are inhibiting our abilities.	IT	Systems / Data - Management
Non-Voting Member	Asset also includes system improvement to optimize use of funding (ePm, Database, New PDBS)	IT	Systems / Data - Management
Non-Voting Member	Data Quality: Should a QIT be established for management?	IT	Systems / Data - Management
Voting Member	Identify priority systems and where the data should reside. Where is our system money best spent?	IT	Systems / Data - Management
Voting Member	Improve systems to better manage our money (Free up contingences)	IT	Systems / Data - Management
Voting Member	Increase data quality management	IT	Systems / Data - Management
Voting Member	Data quality: is there a lack of credibility?	IT	Systems / Data - Management
Non-Voting Member	Shouldn't our systems (technology) be another asset we should manage?	IT	Systems/Data-Integration
Voting Member	Incorporate highway safety manual in standards process – as well as early project involvement	T&S	Systems/Data-Integration

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Legend:

Voting Member Comment
Non-Voting Member Comment
FHWA Member Comment

Appendix D - Gap Analysis Questions and Voting Results

UDOT Asset Management Steering Council Gap Analysis Questions

UDOT Systems / Data

- **UDOT has established a quality data information architecture to promote the integration of business systems for unified asset management**
- **Business systems are treated as a strategic asset to help make data driven decisions.**

1. Very Important	1. Excellent
2. Important	**2. Above Average**
3. Somewhat Important	**3. Average**
4. Of Little Importance	**4. Below Average**
5. Unimportant	**5. Poor**

- **Necessary data is easily accessible to make data driven cost/benefit decisions.**

1. Very Important	1. Excellent
2. Important	**2. Above Average**
3. Somewhat Important	**3. Average**
4. Of Little Importance	**4. Below Average**
5. Unimportant	**5. Poor**

UDOT Project Prioritization

- **A clear, well documented state-wide prioritization process is in place.**

1. Very Important	1. Excellent
2. Important	**2. Above Average**
3. Somewhat Important	**3. Average**
4. Of Little Importance	**4. Below Average**
5. Unimportant	**5. Poor**

- **Management plans have been / are being developed for ***pavements*** including lifecycle analysis, identification of performance measures, and data required for cross analysis.**

1. Very Important	1. Excellent
2. Important	**2. Above Average**
3. Somewhat Important	**3. Average**
4. Of Little Importance	**4. Below Average**
5. Unimportant	**5. Poor**

- **Management plans have been / are being developed for ***bridges*** including lifecycle analysis, identification of performance measures, and data required for cross analysis.**

1. Very Important	1. Excellent
2. Important	**2. Above Average**
3. Somewhat Important	**3. Average**
4. Of Little Importance	**4. Below Average**
5. Unimportant	**5. Poor**

- **Management plans have been / are being developed for ***other assets*** including lifecycle analysis, identification of performance measures, and data required for cross analysis.**

1. Very Important	1. Excellent
2. Important	**2. Above Average**
3. Somewhat Important	**3. Average**
4. Of Little Importance	**4. Below Average**
5. Unimportant	**5. Poor**

UDOT Funding

- **The types of funding, the uses of funding, and the process to fund projects is transparent.**

1. Very Important	1. Excellent
2. Important	**2. Above Average**
3. Somewhat Important	**3. Average**
4. Of Little Importance	**4. Below Average**
5. Unimportant	**5. Poor**

UDOT Performance Measures

- **Asset management performance measures are consistent with the UDOT strategic direction and with the criteria used to set program priorities, select projects, and allocate resources.**

1. Very Important	1. Excellent
2. Important	**2. Above Average**
3. Somewhat Important	**3. Average**
4. Of Little Importance	**4. Below Average**
5. Unimportant	**5. Poor**

UDOT Risk Assessment

- **Resource allocation includes assessment of probability and severity of risk associated with each asset.**

1. Very Important	1. Excellent
2. Important	**2. Above Average**
3. Somewhat Important	**3. Average**
4. Of Little Importance	**4. Below Average**
5. Unimportant	**5. Poor**

Collaboration

- **UDOT liaison's with local governments share information and knowledge to further the development of asset management in Utah.**

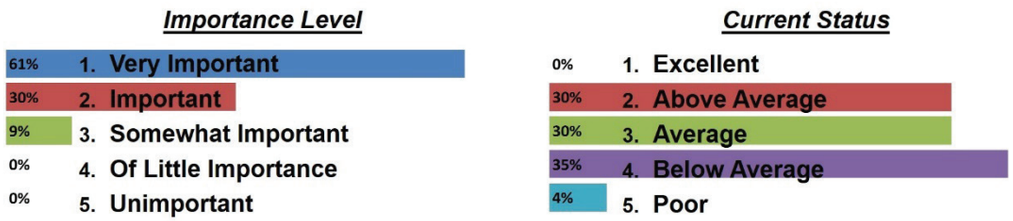
1. Very Important	1. Excellent
2. Important	**2. Above Average**
3. Somewhat Important	**3. Average**
4. Of Little Importance	**4. Below Average**
5. Unimportant	**5. Poor**

Gap Analysis Voting Results

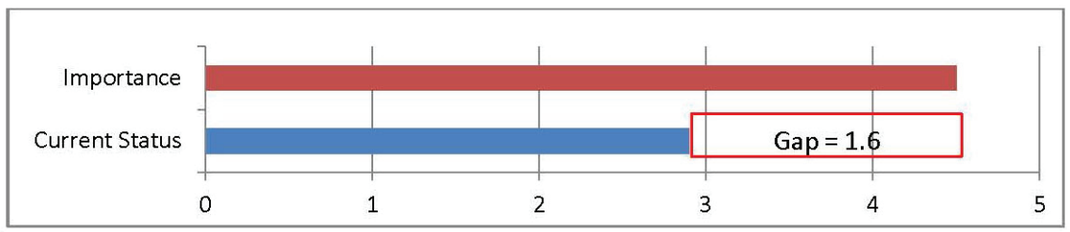
UDOT Systems / Data

Information Architecture

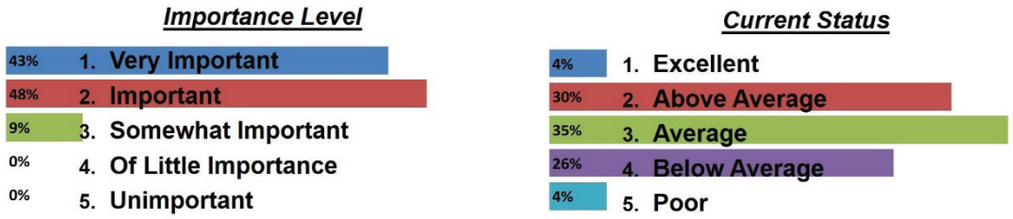
#1 Survey Results:
UDOT has established a quality data information architecture to promote the integration of business systems for unified asset management.



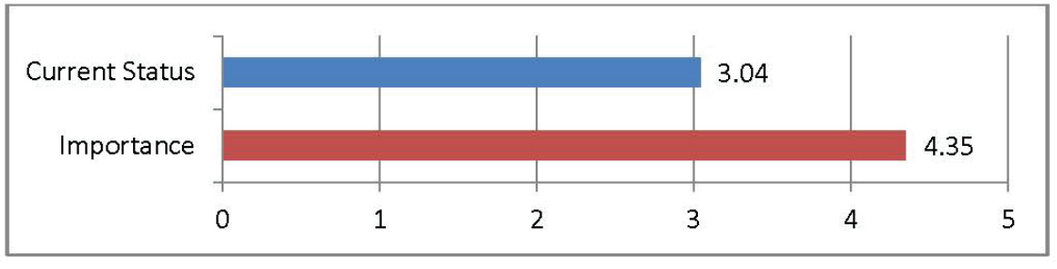
Gap Analysis:



#2 Survey Results:
Business systems are treated as a strategic asset to help make data driven decisions.

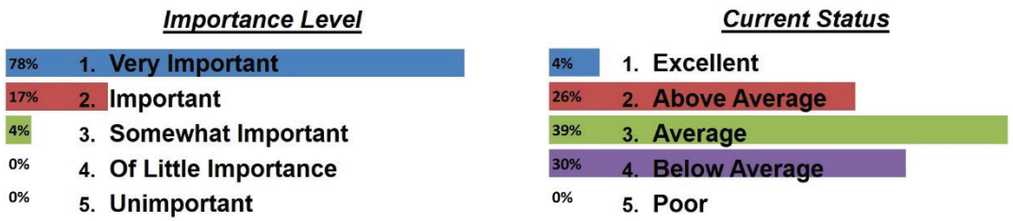


Gap Analysis:



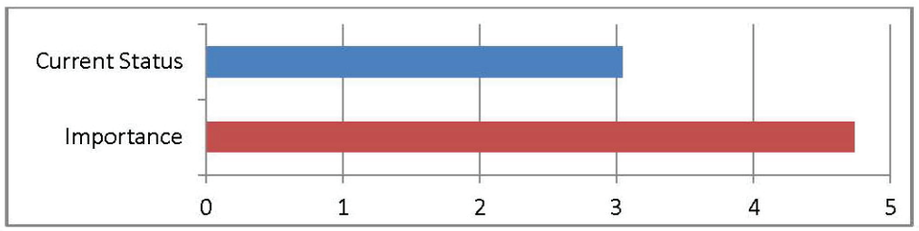
Necessary Data Available

#3 Survey Results:
Necessary data is easily accessible to make data driven cost/benefit decisions.



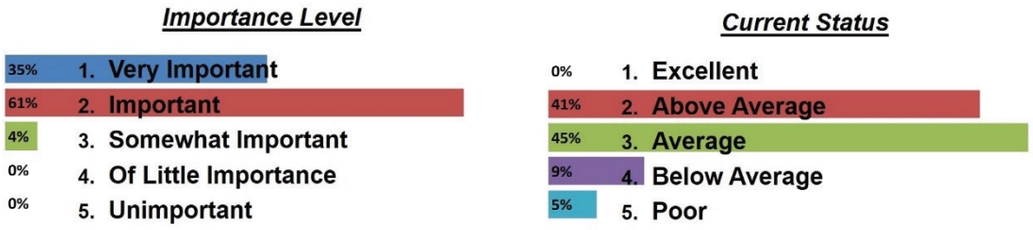
Gap Analysis

UDOT Project Prioritization

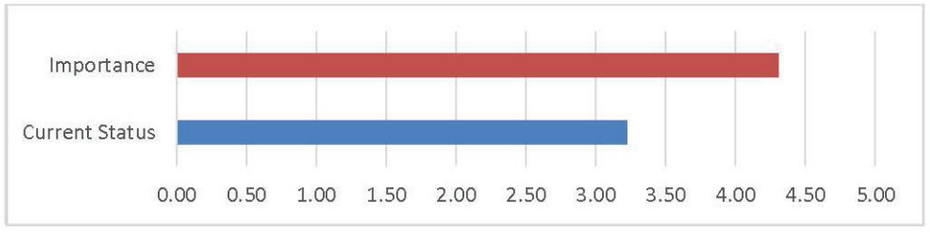


Prioritization Process

#4 Survey Results:
A clear, well documented state-wide prioritization process is in place.

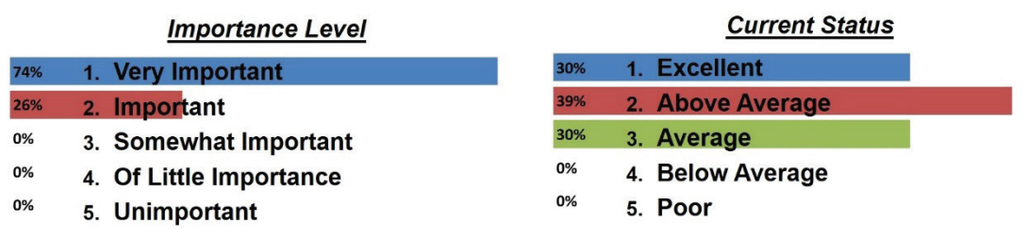


Gap Analysis:



Management Plans for Pavements

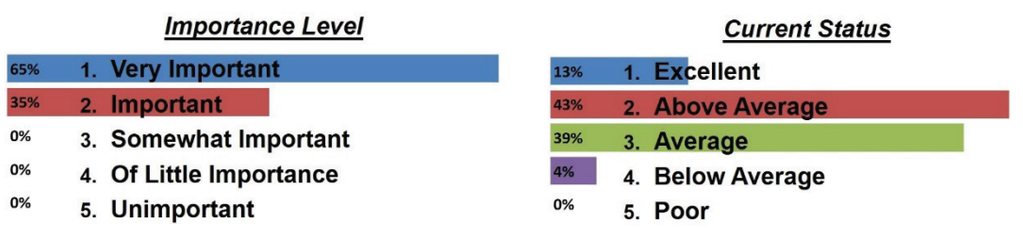
#5 Survey Results:
Management plans have been / are being developed for pavements including lifecycle analysis, identification of performance measures, and data required for cross analysis



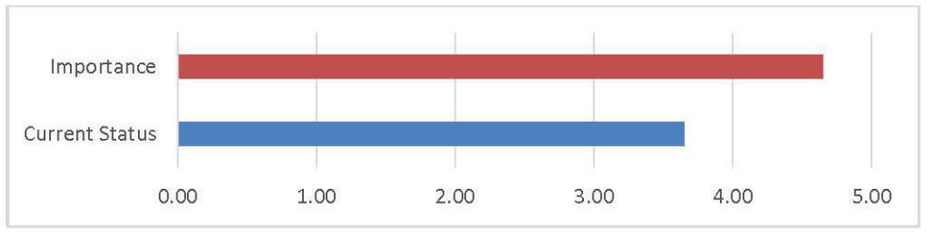
Gap Analysis:

Management Plans for Bridges

#6 Survey Results:
Management plans have been / are being developed for bridges including lifecycle analysis, identification of performance measures, and data required for cross analysis.

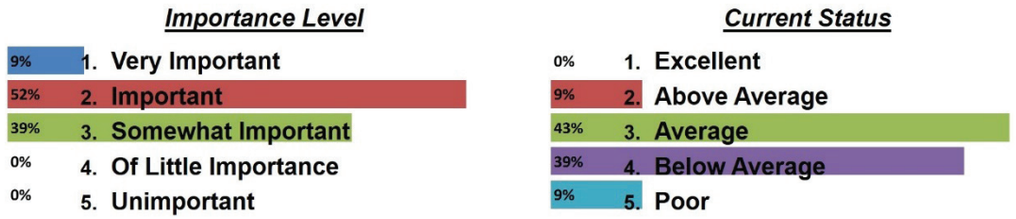


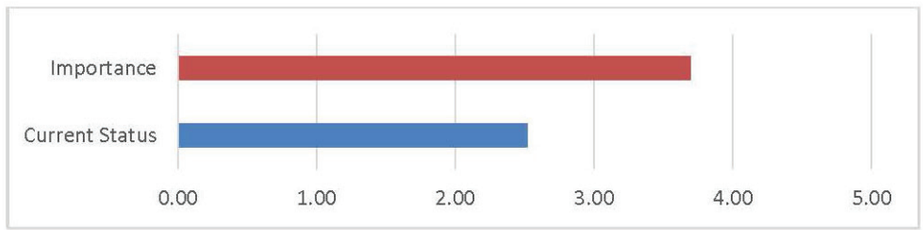
Gap Analysis:



Management Plans for Other Assets

#7 Survey Results:
Management plans have been / are being developed for other assets including lifecycle analysis, identification of performance measures, and data required for cross analysis.



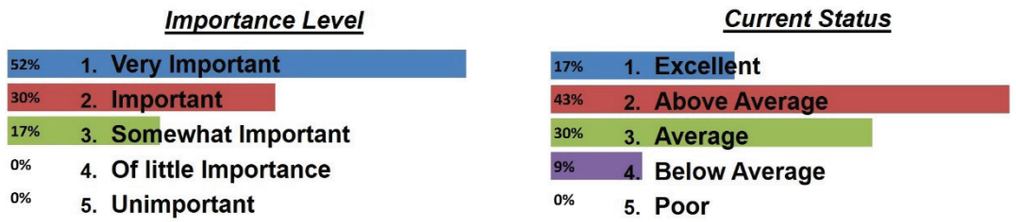


Gap Analysis:

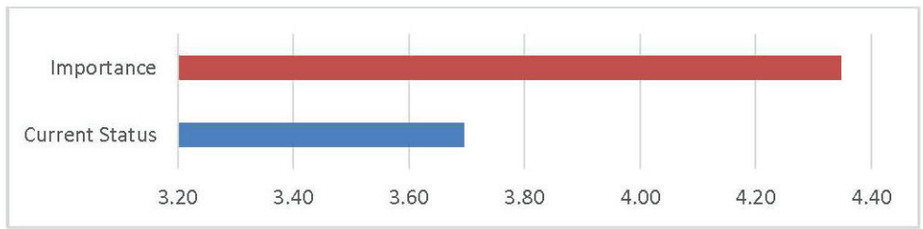
UDOT Funding

Funding Transparency

#8 Survey Results:
The types of funding, the uses of funding, and the process to fund projects is transparent.



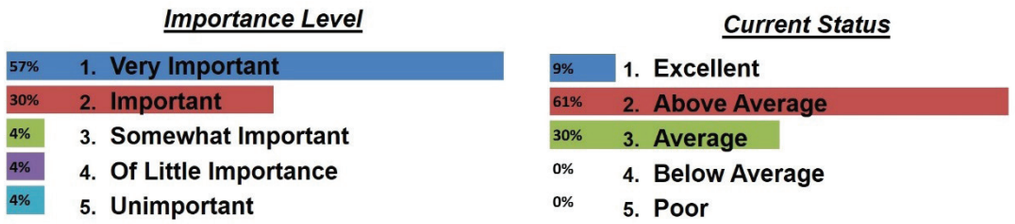
Gap Analysis:



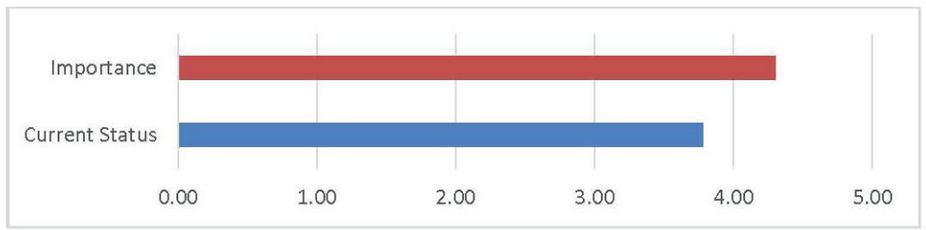
UDOT Performance Measures

Alignment of Performance Measures

#9 Survey Results:
Asset management performance measures are consistent with the UDOT strategic direction and with the criteria used to set program priorities, select projects, and allocate resources.



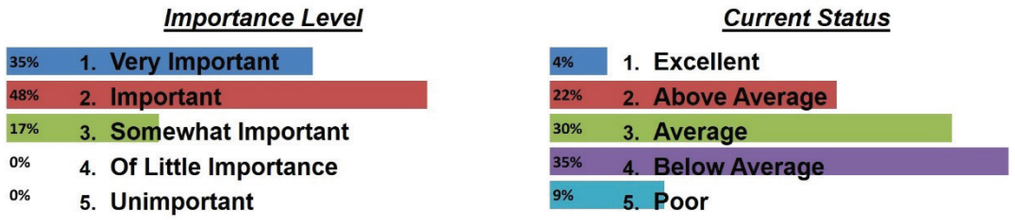
Gap Analysis:



UDOT Risk Assessment

Risk Assessment

#10 Survey Results:
Resource allocation includes assessment of probability and severity of risk associated with each asset.

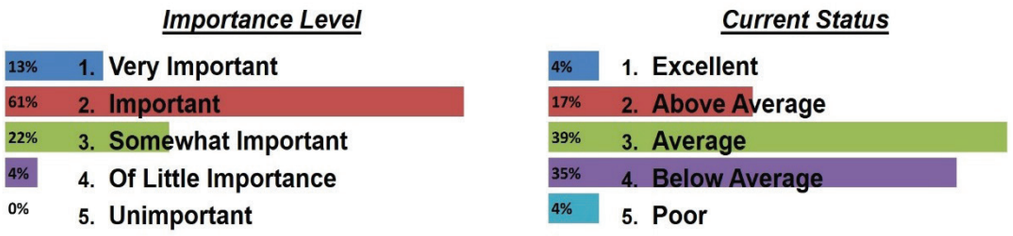


Gap Analysis:

Collaboration

Local Government Collaboration

#11 Survey Results:
UDOT liaison's with local governments share information and knowledge to further the development of asset management in Utah.



Gap Analysis:

Appendix E - Roadmap Implementation Plan

Each division is responsible for completing a variety of tasks specifically focused on ensuring successful completion of the objectives in the roadmap. The tasks are divided into 1, 3, and 5 year sections for each of the three objectives shown on Table 5-Table 7. Risks and the associated risk mitigation are identified for each of the tasks by the responsible division. An assessment of each programmatic risk has been estimated as a combination of the probability and impact as shown in Figure 34.

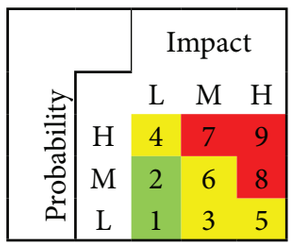


Figure 34 - Risk Matrix

Table 5 - Integrated Programs Tasks and Risks

CATEGORY: INTEGRATED PROGRAMS

Year	Responsibility	Task Description	Risk Description	Risk Mitigation	Risk Assessment
1	OBJECTIVE	Develop department plans to support unified program			
1	Planning	Publish 2015 UDOT Statewide Long Range Plan	Model development and new consultant PM	Weekly team meetings and weekly project review meetings	3
1	Planning	Support MPOs in publishing 2015 Regional Transportation Plans	Achieving agreement on project phasing priorities	Use UDOT prioritization model as starting point for the process, actively engage regions in decision making process, comment on MPO prioritization process	4
1	Planning	Initiate I-15 integrated corridor study to inform Wasatch Front area RTP's 2019 update	Unbiased evaluation of potential strategies	Partner dialogue about importance of objectivity, tight scope, proper decision making structure, hire right consultant team	6
1	Planning	Work with Regions to enhance intermediate-range planning processes	Articulating the value of proposed process	Actively work with regions to develop a process that adds value to their processes	6
1	Proj. Dev	Put out 3D plans on selected projects	Work is in progress, no risks identified	Continue to work on implementation plan with Regions	1
1	T & S	Complete safety investment plan system	System shows unexpected results	Testing during development	1
1	Maintenance	Refine performance level budget distribution	Incomplete historical information	Continue to refine factors as history is developed	6
1	Asset Mgt.	Develop a value matrix for tangible assets	Difficulty in quantifying value of one program vs. another may stop or lengthen efforts	Several workshops scheduled this summer with Executives	3
3	OBJECTIVE	Improve/Develop models for specific programs			
3	Planning	Work with MPO partners and UTA to enhance long-range planning process	Agreement on scope of process, joint goals & objectives, joint performance measures, processes for jointly assessing needs and developing strategies to meet identified needs.	On-going partner engagement and discussion about process and collectively working to improve the process	6
3	Proj. Dev	Modify Asset Management Guidelines as needed to reflect program changes	Inability to come to a consensus on which assets need to be managed and how they will be managed.	Continue to work with the AAC and other interested parties to complete the guidance documents.	3
3	Proj. Dev	Unify Region 3 year plans and complete projects from asset management	Inability to implement the usage of the 3 years plans	Work with the AAC and Regions to make sure all projects are accurately reflected in the plans.	1
3	Asset Mgt.	Develop deterioration curves for pavement condition	Lack of quality data may produce inaccurate pavement analysis	Re-establish PFES after 2016 data collection	7
3	Asset Mgt.	Relate program funding to performance goals	Limited ability to explain how funding is allocated between programs	Explore different vendor products	7
3	TOC	Develop asset management program for ATMS assets	Missing data could diminish perceived benefit initially	Inform and manage expectations	3
3	TOC	Create and fine tune performance goals	Lack of consensus on acceptable performance levels	Engage senior leaders in process	1
3	T & S	Leverage safety funding across all projects	Culture unable to adapt, can't reach consensus on value decisions	Engage senior leaders in process	2
3	T & S	Integrate safety analysis into Project Development processes	Culture unable to adapt, negative impact to safety funding	Engage senior leaders in process	6
3	T & S	Integrate science-based crash analysis into all functional areas	Methodology appears too complex or burdensome	Engage senior leaders and provide education on methodology	7
5	OBJECTIVE	Prioritize projects across all categories			
5	Planning	Publish 2019 "Performance Based" Statewide Long Range Plan and regional plans	No partner agreement on plan goals, objectives and performance measures	Conduct performance measure workshop with partners and on-going and continuous discussion with partners	5
5	Asset Mgt.	Engage multiple departments in collaborative decision making	"Silos of excellence" culture prevent development of a Unified Plan	Explore common goals, make it valuable to all	6
5	T & S	Include science-based crash analysis in funding prioritization	Appears too complex and burdensome to overall process	Provide education and training for involve personnel	4

Table 6 - Performance Management Tasks and Risks

CATEGORY: PERFORMANCE MANAGEMENT

Year	Responsibility	Task Description	Risk Description	Risk Mitigation	Risk Assessment
1	OBJECTIVE	Refine performance plans for individual assets			
1	Structures	Define good/fair/poor performance levels	Misconception of definition of terms	Create clear definitions; communicate performance measures in correct context	2
1	Structures	Evaluate funding needs based on established performance levels	Setting justifiable performance levels that maintains the integrity of the system	Establish appropriate performance levels and track funding levels to maintain performance level	6
3	Structures	Create a plan for every structure	Inadequate resources to complete	Establish a plan to complete and obtain necessary resources	4
1	TOC	Automate congestion reporting	None	N/A	1
1	Asset Mgt.	Develop a financial plan with value and risk for tangible assets	Inability to accurately quantify/articulate future financial requirements	Link PDBS/Asset data	2
1	Asset Mgt.	Add deterioration curves to Plan for Every Section analysis	Small sample size may produce inaccurate curves	Link pavement distress data to sections	2
3	OBJECTIVE	Establish data driven performance measures and individual program goals			
3	Structures	Define bridge needs and establish funding	Inability to identify optimal treatments and variability in bridge conditions	Work to gain consistency in defining bridge condition data; review past bridge conditions with past funding to develop a trend	7
3	Planning	Initiate Performance Based Planning Process for statewide & regional plans 2019 update	Internal consensus on implications about how the Final Four and Emphasis areas affect the process of assessing system needs and development of mitigation strategies; integrating performance management into transportation planning; collecting and turning data into information that guides planning decisions; risks with setting specific targets; tools to predict future performance and assess project impacts on performance areas - time lags...	Develop measures that make sense; proactive engagement and collaboration with internal and external stakeholders; build on established performance management approaches; good communication of constraints and trade-offs; link planning and programming; ...	6
3	Asset Mgt.	Refine performance measures to include risk and life-cycle costs	Incomplete information skews reporting on performance measures	Integrate business systems and data	7
5	OBJECTIVE	Prioritize funding across all categories			
5	TOC	Include mobility in funding prioritization	Culture unable to adapt, can't reach consensus on value decisions, lack of confidence in data	Engage senior leaders in process	6
5	Structures	Define benefits of work completed	Insufficient measurement of treatment impacts	Perform research to understand the treatment impacts	7
5	Asset Mgt.	Create unified plan with funding recommendations	Limited ability to explain how funding is allocated between programs	Several workshops scheduled this summer with AAC	6

Table 7 - Organized and Accessible Data Tasks and Risks

CATEGORY: ORGANIZED AND ACCESSIBLE DATA					
Year	**Responsibility**	**Task Description**	**Risk Description**	**Risk Mitigation**	**Risk Assessment**
1	OBJECTIVE	Identify needs and establish framework to integrate data			
1	Proj. Dev	Develop push button concept report data collection	This has been set up and regions are testing--risk is that they don't use it.	Continue to work with the regions on improvements to make sure they are comfortable using the tool.	1
1	Proj. Dev	Develop data warehouse from which departmental financial results can be displayed	Funding and internal resource availability	Work with PMT and UDOT divisions to secure funding and make sure resources can be dedicated to the effort.	6
1	Maintenance	Finish integration of OMS & dTMS to establish system feedback loop	Available programing staff	Hire consultant to provide programing	8
1	Maintenance	Optimize Mandli data input process to automate incorporation with OMS	Data architecture not available and process not developed to store historical data and insert current data	Develop data warehouse and fully implement integration process	8
1	Maintenance	Hire business analyst to provide increased level of service for OMS users	Position availability	Create position by optimizing current Central Maintenance resources	7
1	TOC	Incorporate traffic asset information into UPlan	Lack of resources to complete	Hire consultants	6
1	Asset Mgt.	Update asset data with Phase 2 data collection	Lack of business system integration - OMS/Ugate limits access to historical data	Continue to work together on OMS	9
1	T & S	Complete GIS crash data analysis system	System is not used due to perceived low value, required updating is neglected	Communicate value and make continual updating a priority and automated	5
3	OBJECTIVE	Establish processes for accurate and up-to-date data			
3	Planning	Improve recording and reporting of funding & construction of LRP projects	Accurate, complete recording of long-range plan information and project information in ePM	Work with Project Development and DTS to enhance ePM to enable LRP cross reference and develop communication process with regions to assess whether project scope meets intent of LRP project	4
3	Maintenance	Develop and implement refined OMS system to include all improvements	Availability of programming services	Hire consultant and train staff	6
3	Asset Mgt.	Ensure asset management business systems share data with other business systems	Business systems unable to share data and produce consistent results	Develop data warehouse and fully implement integration process	8
3	Proj. Dev	Create electronic 3D plans for all projects	Unintelligent designs and lost efficiency	Create implementation plan and provide training	2
3	Proj. Dev	Develop data governance plan	Funding availability	Continue to work with the PMT	6
5	OBJECTIVE	Automate dashboard reports			
5	Maintenance	Complete integration of OMS system with other UDOT systems	Programming resources	Have consultant provide programming services to complete integration	5
5	Proj. Dev	Automatically load 3-D as-builts into system	Struggle to maintain as-built information	Develop 3D CADD database and require contractors to submit models that conform with standards	6
5	Proj. Dev	Integrate all business systems with data warehouse	Lack of financial and personnel resource availability	Maintain leadership support	5

Asset Management Tiers

- Tier 1
  - Highest value assets
  - Highest risk of negative financial impact for poor management
  - Very important to UDOT performance plan
  - Has a significant separate funding source
  - Management includes
    - setting targets, goals
    - Sophisticated data collection
    - Predictive modeling and risk analysis

Asset	Value	Financial Risk	Info. Risk	Operational Risk	Safety Risk	Ave. Risk	Tier
Pavement	$24B	6	3	8	7	6	1

Financial –
- Have separate and stable funding source to preserve condition but level 2 roads are underfunded.

Information –
- Data is readily available on all but data is not as good on level 2 roads.

Operational –
- Pavement failure or deteriorated condition adversely impacts mobility in a wide section of system, detours limited or are already carrying heavy load.

Safety –
- Pavement failure or deteriorated condition moderately impacts safety of public travel.

Asset	Value	Financial Risk	Info. Risk	Operational Risk	Safety Risk	Ave. Risk	Tier
Bridges	$5B	6	3	8	8	6	1

Financial –
- Have separate and stable funding source that is not adequate to preserve all bridges at desired condition levels.

Information –
- Data is available from regular inspections and Mandli data but is not as good on off system bridges.

Operational –
- Bridge failure or load posted adversely impacts mobility of a wide section of system, detours limited or are already carrying heavy load.

Safety –
- Bridge failure has very high public safety ramifications.

Asset	Value	Financial Risk	Info. Risk	Operational Risk	Safety Risk	Ave. Risk	Tier
ATMS/Signal Devices	$793M	6	6	5	5	5.5	1

Financial –
- Separate funding source is available and not adequate for needs.

Information –
- Location data available, accurate data is currently not available on age or condition of devices.

Operational –
- Replacement activities are likely and moderately impact operations.

Safety –
- Failure is a significant safety hazard but redundant devices temporize consequences.

Asset Management Tiers

- Tier 2
  - Moderate value assets and substantial importance to transportation system operation
  - Moderate risk of negative impact for poor management or asset failure
  - May have a separate funding source
  - May be lack of redundancy that increases risk
  - Management includes
    - Accurate data collection, less than annually
    - Risk assessment primarily based on asset failure
    - May include spreadsheet predictive strategy
    - May include condition targets for proactive strategies

Asset	Value	Financial Risk	Info. Risk	Operational Risk	Safety Risk	Ave. Risk	Tier
Pipe Culverts	$1B	6	7	5	3	5	**2**

Financial –
- Limited separate funding and not adequate for regular preservation activities. However, pipe culverts are routinely included in pavement preservation projects.

Information –
- Limited location data is available and is difficult to obtain due to urban linked piping systems.
- Condition is unknown and is difficult and costly to obtain.

Operational –
- Pipe culvert failure may have significant mobility impact depending on traffic volumes and extent of failure, reconstruction may take significant effort due to conflicts with utilities and other assets but probability of failure is low.

Safety –
- Pipe culvert failure likely to have advance warning of water back up or sagging pavement and therefore lesser safety risk and low probability.

Asset	Value	Financial Risk	Info. Risk	Operational Risk	Safety Risk	Ave. Risk	Tier
Signs	$300M	7	5	3	3	4.5	2

Financial –
- Very limited separate funding source available.

Information –
- Data is available on location but not condition
- Sign age is unknown prior to 2004.
- Percentage meeting current standards unknown.

Operational –
- Sign structure failure may have significant operational impact.
- Sign redundancy reduces operational risk.

Safety –
- Regulatory signs replaced immediately when necessary.
- Other missing or damaged signs replaced as a project element.

Asset	Value	Financial Risk	Info. Risk	Operational Risk	Safety Risk	Ave. Risk	Tier
Walls	$3.4B	3	3	5	3	3.5	**2**

Financial –
- No separate funding source and not regularly included in preservation projects.

Information –
- Data is available on location but not condition.

Operational –
- Wall failure may have significant impact on system mobility depending on height and location. Many can be reconstructed in shoulder area with limited operational impact.

Safety –
- Wall failure consequences depend heavily on height and location and failure is very rare.

Asset	Value	Financial Risk	Info. Risk	Operational Risk	Safety Risk	Ave. Risk	Tier
Rumble Strips	$ 6M	3	4	2	5	3.5	2

Financial –

- Rumble strips are installed as project elements.

Information –

- Location information is available, condition data is not easily collected.

Operational –

- Replacement activities are completed on the shoulder with low impact to operations.

Safety –

- Failure is a moderate safety hazard with moderate consequences due to other safety features such as shoulders, guard rails, etc.

Asset	Value	Financial Risk	Info. Risk	Operational Risk	Safety Risk	Ave. Risk	Tier
ADA Ramps	$ 20M	2	2	1	5	2.5	2

Financial –

- Separate funding source is available for required installations.

Information –

- Data is not easily available on location.
- Condition is monitored by maintenance as part of other activities.

Operational –

- Replacement and installation activities do not significantly impact operations.

Safety –

- Failure is a moderate safety hazard with moderated probability.

Asset	Value	Financial Risk	Info. Risk	Operational Risk	Safety Risk	Ave. Risk	Tier
Barrier	$450M	3	1	4	2	2.5	2

Financial –

- Separate funding source is available to add barrier where needed based on safety assessments, if funding lost would have negative impact on fatalities.

Information –

- Data on location and type collected routinely.

Operational –

- Barrier usually can be repaired and added in the median or on the shoulders with minimal impact to system mobility.

Safety –

- Barrier is repaired and replaced by maintenance as needed due to crashes and most of the time still effective even when hit.

Asset	Value	Financial Risk	Info. Risk	Operational Risk	Safety Risk	Ave. Risk	Tier
Pvt. Markings	$ 42M	2	1	2	5	2.5	2

Financial –

- Maintenance allocates funding for pavement markings every year.

Information –

- Data is readily available on location, amount and type of markings.

Operational –

- Replacement activities are rolling and do not significantly impact operations.

Safety –

- Failure is a moderate safety hazard but probability is moderated due to maintenance monitoring condition.

Asset Management Tiers

- Tier 3
  - Low value assets
  - Low risk of negative impact for poor management or asset failure
  - Management includes
    - Accurate data collection, less than annually
    - Risk assessment primarily based on asset failure
    - Included in projects when condition warrants
    - Reactive - Repaired or replaced when damaged

Assets Managed as Tier 3

Asset	Tier
Cattle Guards	3
Interstate Lighting	3
Fences	3
Rest Areas	3
Curb and Gutter	3
Trails	3
Bike Lanes	3
Surplus Land	3
At-grade crossings	3