

## Case Study:

# Saving Money and Improving Operations and Maintenance with INVEST

**Lead Agency:** Utah Department of Transportation (UDOT)

**INVEST Modules:** Operations and Maintenance

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Using the pilot version of INVEST in winter 2011-2012, the Utah Department of Transportation (UDOT) developed specific recommendations for sustainability improvements to its operations and maintenance program. UDOT then performed a new self-evaluation in the summer of 2014 using INVEST 1.0 to measure progress and identify room for improvement. UDOT found that it had made sustainability progress in a number of areas. UDOT also calculated substantial cost savings from implementing two of the recommendations from evaluation with INVEST criteria OM-7 and OM-13. This case study provides 1) information on UDOT's progress from 2012 to 2014, 2) examples of how implementing INVEST recommendations saved the agency money, and 3) UDOT's recommendations for future actions.

## Progress from 2012-2014

For both the scoring efforts in 2012 and the one in 2014, UDOT held meetings with several senior leaders and staff to discuss INVEST scoring and sustainability strategies. All participants were very open and readily acknowledged both strengths and shortcomings. Participants included managers and staff in environmental protection, structural engineering, bridge management, traffic management, construction and materials, maintenance, asset management, pavement, operations, and finance.

As in the earlier evaluation, UDOT's 2014 evaluation showed the agency doing very well at executing sustainable practices as it relates to its core business functions, such as pavement management. UDOT is still lagging in regards to overall "strategic" sustainability plans such as, internal sustainability, electrical energy efficiency, and recycle and reuse.

Throughout and following the 2012 INVEST evaluation, participants from UDOT identified opportunities for improved sustainability in a variety of areas. For each recommendation, UDOT identified the priority, benefit, responsible division, relation to sustainability, level of effort/cost, and ease of implementation. During the 2014 re-evaluation with INVEST, UDOT measured progress towards the 2012 recommendations. Three of the four high priority recommendations were met and one was partially met. Of the five medium priority recommendations, two were met and three were partially met. The two low priority recommendations were not met. The box at right shows the status of

**Recommended Action:** Produce a proactive Bridge Management System (BMS)

**INVEST Criterion:** (OM-08 Bridge Management System)

**Priority:** High

**Benefit(s):** Maximized bridge life.

**Responsible Division:** Structures

**Relation to Sustainability:** Maintaining and using a bridge management system supports the environmental and economic principles by optimizing the management of bridge structures, including preservation, restoration, and replacement, to maximize their lifetimes. This reduces costs, the environmental impacts of construction, and raw material usage.

**Effort/Cost:** High effort.

**Ease of Implementation:** Required coordination with Asset Management, Regions, and Maintenance to implement.

**Recommendation Progress - Met:** UDOT has implemented a BMS. The database contains the necessary information to allow for planning and programming. Different metrics are used for each structure type. It tracks functional and operational items. UDOT attempted to adapt the pavement management software but it wasn't sophisticated enough to model individual elements of the structure – it produced projects that didn't make sense, such as fixing one joint of a structure. UDOT will use PONTIS for BMS when the new version is released this year. As a result of implementing a BMS, UDOT's score on INVEST OM-08 increased by 7 points.

one of the recommendations. For similar information on the other 10, see [UDOT's full report](#).

## Saving Money with INVEST OM-7 Pavement Management System

Another high priority recommendation that came out of the 2012 INVEST self-evaluation was to implement collected LIDAR data into UDOT's Pavement Management System (PMS). This would improve the consistency of the pavement condition data and lead to better results from the PMS. The PMS recommends the treatment, timing, location and funding levels for pavement projects. Improvements to UDOT's already sophisticated PMS would then maximize pavement lifetimes, decrease costs, lessen the environmental impacts of construction, and reduce raw material usage.

The recommendation also supplemented an effort at the time to switch from manual pavement condition assessment to automated data collection. Prior to 2012, UDOT collected pavement condition data manually by inspecting each tenth of a mile segment every two years. Staff photographed conditions and assessed ride quality. This information was then used to populate the state's PMS.

Starting in 2012, UDOT switched from manual inspection to automated collection of state-of-the art 3D pavement distress data. The automated collection provided detailed cracking, rut and faulting distress data that is quantified by exact length, width and depth. The Department is now able to recommend specific projects, allocate funding, and predict future pavement performance more accurately than before. UDOT has estimated an annual cost savings of \$3.4 million in improved pavement management practices and projects.

UDOT's vendor also collected system-wide LIDAR data concurrently with the pavement distress information. Using the LIDAR data presented some early challenges due to the large amounts of information contained in the point cloud. UDOT worked with the vendor and outside consultants to refine and calibrate the data to improve the accuracy to plus or minus one inch. The uses of the calibrated point cloud continue to expand. UDOT has already identified many cost savings and uses for this data, as shown in the box at right.

Adding up the total savings and dividing by the costs yields a benefit cost ratio of 3.5, meaning that the monetary benefits to UDOT of implementing the recommendation outweigh the costs by three and a half times.

The implementation of the automated data supports sustainability concepts on many different levels. Much of the cost savings involves reduced time spent by personnel in the field and the associated travel. The reduced travel results in fewer emissions from burning less fossil fuel. The safety of personnel is improved because of the reduction in exposure to traffic. The improved pavement distress data provides better decision making criteria in the PMS. By performing the correct treatments at the right time, paving materials will be utilized to their maximum benefit.



### Collection of Mobile Automated System-wide Pavement and LIDAR Data

#### Savings

- \$3.4M in improved pavement management practices and projects
- \$85K saved annually in outdoor advertising inventory and measurements
- \$26K saved annually in Highway Performance Monitoring System (HPMS) field measurements
- \$90K saved annually in field measurements for smaller pavement preservation design projects
- \$125K saved annually in Maintenance Management Quality Assurance (MMQA) data collection and features inventory database
- \$39K saved annually in field investigation to prepare Concept Reports for design projects
- \$100K saved annually in surveying for applicable larger design projects
- **Total:** \$3.9M total per year, \$7.8M every 2 years

#### Costs

- \$2.2 million every 2 years

#### Benefit Cost Ratio

**3.5**

## Saving Money with INVEST OM- 13 Transportation Management and Operations

Another recommendation that came out of the INVEST self-assessment was to implement a “World Class” signal timing program with multiple ITS solutions and performance measures for traffic signal operations. The Department committed \$3 million annually to accomplish this target. UDOT has successfully implemented the following to meet this lofty target:

Through a partnership with Indiana DOT and Purdue University, UDOT implemented real time performance measurement of traffic signals. This allows UDOT to assess the effectiveness of traffic signal timing and coordination plans in real time. Resources can be directed to address the intersections and corridors in the most need of signal timing adjustments. Savings are estimated at \$3 million annually in user costs. These savings will increase as additional signals are equipped to measure their performance.

Dynamic dilemma zone detection was installed on higher speed corridors to reduce crashes. This equipment measures the speed and size of approaching vehicles to a signal. If the determined speed is above the established threshold for adequate stopping distance, the signal timing is adjusted to hold the red light a fraction longer for the stopped vehicles. Data has shown this reduces by 50 percent the likelihood of high speed T-bone crashes that often result in severe injuries. Predicted annual savings are \$495,000 in user cost safety savings.

UDOT has expanded its effort to provide improved traffic signal operations support for events that have regional traffic impacts. Examples of events that are supported include college football and basketball games, events at Energy Solution Arena, Hill Air Force Base Air Show, and various firework shows. This effort includes coordinating with event planners and local jurisdictions, developing traffic signal timing plans, implementing a public involvement plan, and execution during event loading and unloading periods. Annual savings in user costs are greater than \$1.2M.

Corridor responsive ramp metering was installed to allow real time metering rate adjustments to improve traffic flow on ramps and interstates. This system monitors traffic volumes on both the ramps and mainline and makes appropriate adjustments to the metering rate in real time. Measurements indicate peak hour mainline speeds have increased an average of 18% and volume has increased by 8%. Annual user cost savings are estimated at \$170,000. UDOT is currently performing a study to investigate the feasibility/benefits of enhanced ramp metering and managed lanes.

UDOT installed a traffic adaptive signal system on a major corridor (US-40) in Heber City. Signal timing is automatically adjusted in real time based on current traffic demand. The average daily delay has been reduced by 30% and corridor travel time has decreased by 6%. The user cost savings are \$310,000 annually.



### Improved Traffic Signal Operations

#### Savings

- \$3M in user congestion savings – routine real-time performance measurement
- \$495k in user safety savings
- \$1.2M in user congestion savings – special events
- \$170k in user congestion savings – ramp metering
- \$310k in user congestion – traffic adaptive signal system

**Total: \$5.2M**

#### Costs

- \$3M

#### Benefit Cost Ratio

**1.7**

The improvements to traffic signal operations support sustainability in multiple ways. The Wasatch Front (Salt Lake City, Davis County, and Weber County) is a non-attainment area. In the winter, particulates are the problem. Ozone becomes the issue in the hotter summer months. Vehicle emissions are a major contributor in both instances. These implemented improvements reduce traveler delay and idling vehicles. Both of which lead to improved air quality and reduction in use of fossil fuels. Traffic delays also impact the overall economy. Goods and service providers are able to move more efficiently to meet their schedules. Individuals spend less time on the road – allowing them more productive time each day. The safety enhancements reduce crashes and the resulting property damage, injuries, and associated traffic delays.

### Next Steps

While UDOT's most recent INVEST evaluation revealed that the sustainability of the agency's operations and maintenance program is strong and improving, striving for even further improvement, UDOT developed six additional recommendations for future action. One of these is highlighted in the box at right. See [UDOT's report](#) for a full description of the entire set.

### Key Outcomes of Using INVEST:

- Provoked specific recommendations about how to incorporate sustainability concepts into an organization and integrate into the daily culture.
- Most of the recommendations from the first round evaluation were met or partially met, resulting in substantial sustainability benefits: improved air quality; reduction in fossil fuel usage; reduced injury crashes; overall economy benefits; reduced user delay; improved employee safety; and maximization of pavement service life.
- Cost benefit analyses demonstrated high rewards.

**Recommended Action:** Produce an Overall Internal Sustainability Plan. This document would focus on internal practices of UDOT. It would contain items relating to resource and energy use and pollution generation. It could be general or specific in nature in regards to recycling, etc. Performance measures could be included. One potential option is to provide a general guideline document to the UDOT Employee Committee with instructions to produce guidelines for recycling; energy usage; etc., and performance measures. Assemble existing documents and practices to include that relate to sustainability.

**INVEST Criterion:** OM-1 Internal Sustainability Plan

**Priority:** Lower

**Benefit(s):** Improve internal awareness and practices concerning energy and resource usage.

**Responsible Division:** Administration

**Relation to Sustainability:** This document would define UDOT's goals relating to sustainability, define measures to improve sustainability, and potentially lay out performance measures to track progress and sustainability.

**Effort/Cost:** The effort could be small to large depending on the establishment and monitoring of performance measures. A limited pilot plan with several key measures that have data currently available would work best initially.

**Ease of Implementation:** Commensurate to the detail in the overall plan. Could range from simple education to an extensive tracking system.