# Better reporting

Utah DOT's data and planning tools provide a guide
to the future and power of network-level asset data

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While the U.S. DOT works feverishly to complete MAP-21's new bridge, pavement and asset-management data requirements, the Utah Department of Transportation (UDOT) provides a guide for how to use public-private partnerships to take risk-based asset management to a whole new level and create the type of management system envisioned by Congress.
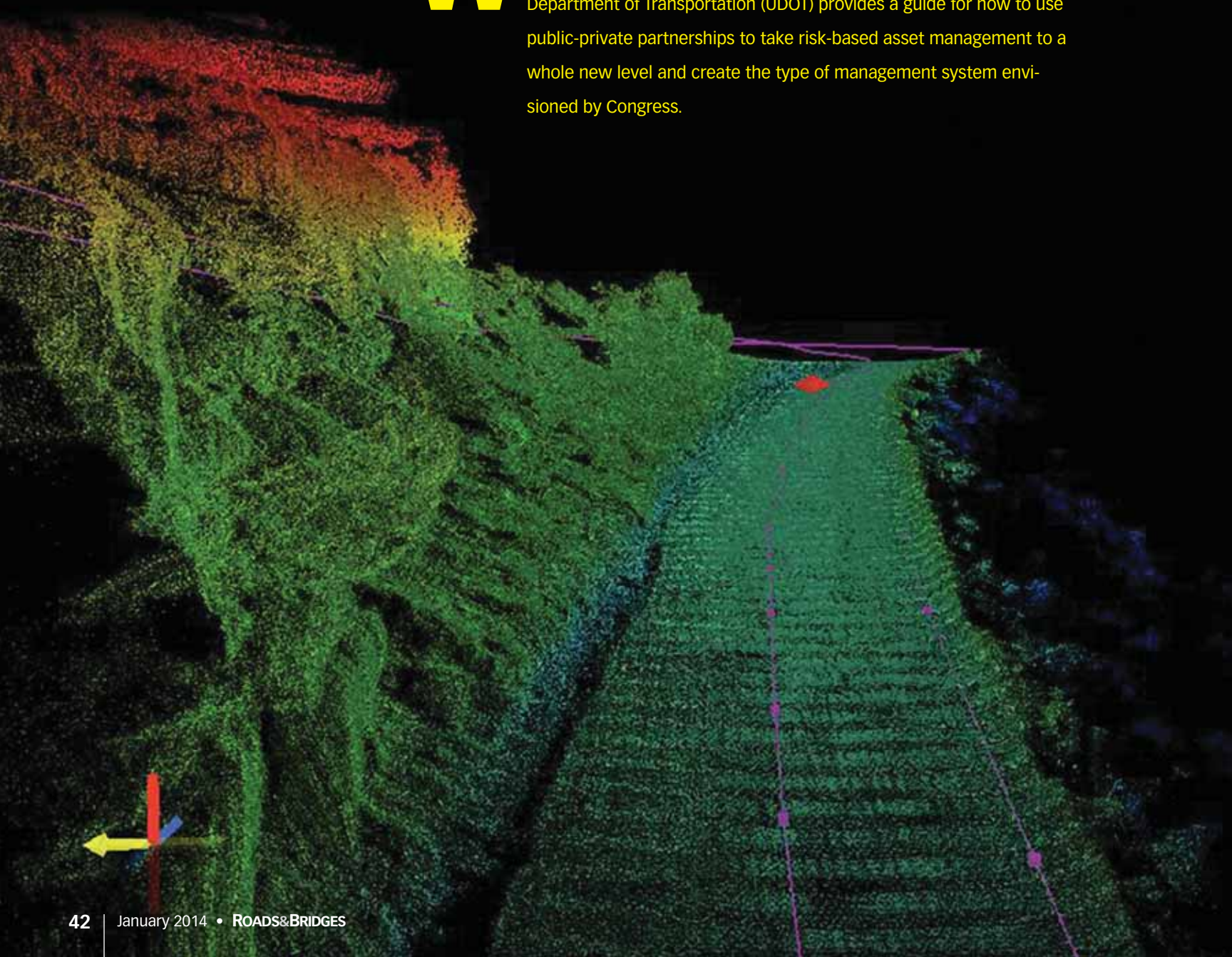
The passage of MAP-21 by Congress in 2012 officially transitioned the primary federal focus in surface transportation from interstate and National Highway System (NHS) construction to system management. There is a growing sense among policy makers that with each passing day, increased congestion in key corridors is hurting interstate commerce and U.S. global competitiveness. Before coalescing on new funding mechanisms, policy makers streamlined current federal-aid programs and seek better asset-management, condition and performance data.

The current legislative director for Sen. James Inhofe, Alex Herrgott, worked on MAP-21's data-policy sections.

"MAP-21's data and reporting requirement provisions were designed to help effectively demonstrate the impact of an increasingly dysfunctional National Highway System on GDP and the economy," Herrgott explained. "Every day we become less competitive as our transportation system becomes increasingly inefficient. We need better tools to demonstrate needs and effective management practices that maximize the current investment. MAP-21 provides an opportunity for states to build a 21st-century management style so serious conversations on levels of investment can occur from a common and credible platform of needs data."

According to Herrgott, officials were mindful of transportation investments being made in China, Brazil and beyond: "The economic life's blood of the interior of the country is our transportation network. As these networks become less and less efficient compared to regional and global competitors, businesses will choose to go elsewhere. This is especially true of congestion on the National Highway System."

Prior to the 2010 elections, it was presumed that the federal transportation reauthorization bill would be shaped by Chairman James Oberstar of the House Transportation and Infrastructure Committee. His unexpected defeat shifted momentum to the U.S. Senate. By spring 2011, the Senate worked on the final structures that would eventually become MAP-21.

New MAP initiative

In 2010, Utah's planning and GIS staffs asked program heads to provide spatial data valuable for use by other departments. Traditionally, pavement, bridge, planning, traffic and other data sets were routinely collected and hoarded within division silos. Under this new initiative, data sets were incorporated into an integrated Oracle-based platform. A new web-based content-management system (ESRI ArcGIS) allowed users to analyze

integrated data sets to better develop and illustrate planning and investment decisions. Maps were developed that incorporated all the known asset, environmental, planning, traffic-safety and operations data to provide a more complete condition and performance picture of the state's transportation network.

Given the web-based nature of the system, it became easier for planners to place increasing amounts of data on the UDOT website. This "UPlan initiative" to increase transparency and enhance cross-departmental data utilization received acclaim within UDOT, among state legislators, from AASHTO and the U.S. DOT. UPlan became an AASHTO TIG project in 2011, and U.S. DOT would eventually incorporate the "UPlan model" as an FHWA Every Day Counts initiative for 2013.

In spring 2011, Utah's director of asset management, Stan Burns, reviewed various scenarios for updating pavement-distress data. Research into the latest technologies led Burns to a suite of innovative mapping and asset-collection technologies that could capture and inventory every asset within the right-of-way. He immediately thought of UPlan.

"Utah may not be the 'show me' state, but we believe that a risk-based asset management program is only possible with accurate and reliable data," Burns said. "As I discussed what was possible with maintenance, traffic


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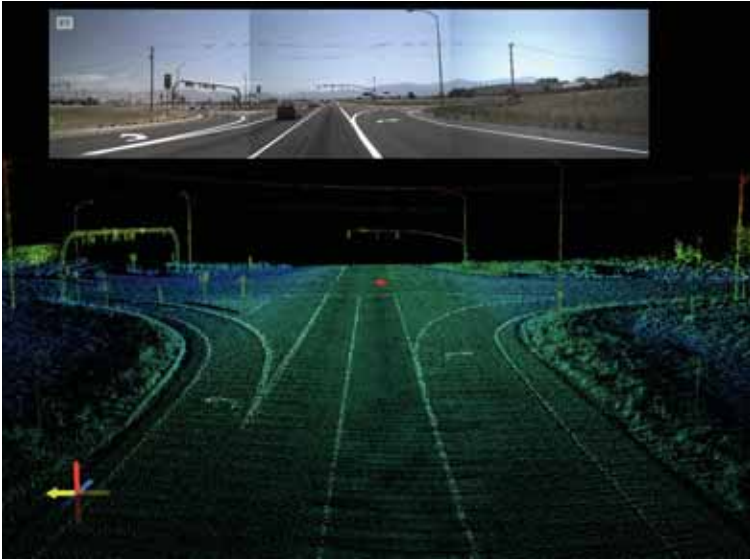
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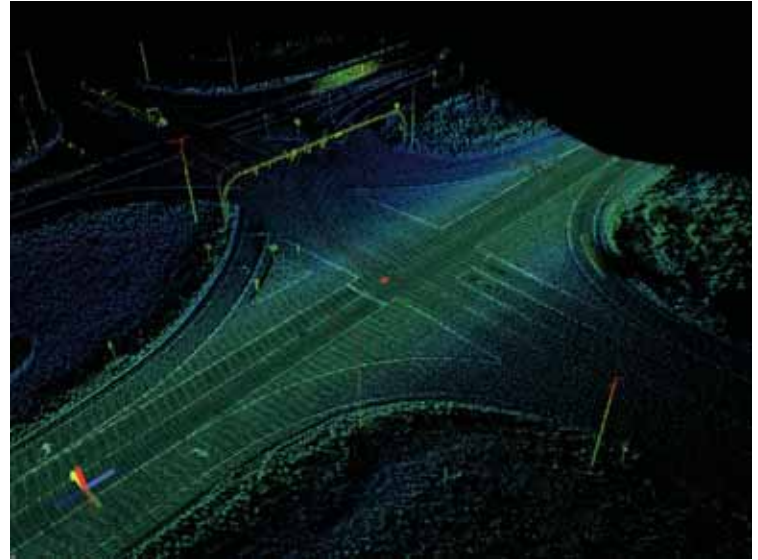
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safety, planning, our GIS staff and other key members of our leadership team, it became readily apparent that different departments were collecting duplicate data sets and that working together we could invest in a data set worthy of the UPlan system and our asset-management goals."

One of the major obstacles to investing in new technologies or processes is the lack of internal expertise to ensure quality of results. This project was no different. In developing their request for proposals, Utah's staff developed a rigorous QC/QA testing course. Each potential vendor was required to collect a previously surveyed course, and the vendor's data sets were checked against this baseline for accuracy. Once the data was collected and processed, each qualifying vendor would spend an entire day with UDOT staff demonstrating how data sets could be used within their systems.

In fall 2011, UDOT released their Roadway Imaging and Inventory proposal. It called for the collection of 14,000 miles of geolocated road geometry, pavement distress, surfaces, imagery, lane-mile, bridge clearance and sign data. Eventually the contract expanded to require collection of nearly all right-of-way assets. The rigorous prequalification process greatly reduced the number of applicants. The winning contractor, Mandli Communications, used a mobile platform outfitted with GPS, photolog cameras, a surface profiler, a laser crack-measurement system, lidar sensors and a beta version of a sign retroreflectivity system. Assets were geolocated, categorized and inventoried.

Vendors mobilize

Shortly after President Obama signed MAP-21 into law in Summer 2012, UDOT hosted a meeting in Salt Lake City to introduce this new network-level asset-collection project to their database and system vendors. This Aug. 15 meeting was hosted by Utah Planning Director John Thomas and Stan Burns and included representatives from Oracle, ESRI, Deighton, Agile Assets, Bentley Systems and Mandli Communications. The Utah Transportation Integrated Business System (UTIBS) initiative sought to create an environment in which data is accessible through one portal without duplicating or manipulating the data. They wanted to seamlessly incorporate newer versions of data and have all business systems work together.

According to UDOT, UPlan would not have been possible without tremendous assistance from ESRI's ArcGIS web-system-development team. ESRI's team looked at UPlan as an opportunity to demonstrate the horsepower of their newest version of ArcGIS in bringing transportation data to life. As the focus turned to organizing and integrating the enormous sums of lidar and other asset data, the initial focus shifted to Oracle for the data platform and point-cloud analysis, while Deighton and Agile Assets worked to ensure that data could be effectively organized and managed within key departments.

Getting vendors to work together on this type of project, however, was a challenge.

"Given MAP-21's emphasis on asset management and performance measures, we believed that this type of network-level data collection and utilization would pay great dividends for UDOT and for our vendors," explained Burns. "Utah has a relatively small network of roads, and we were offering our vendors an opportunity to use this data to develop enhancements to

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their systems that could be offered later in more complex environments."

The Aug. 15 meeting resulted in the development of four working subgroups: database (UGate), roadway design, asset management and traffic safety.

While the core group of Utah vendors began work on various aspects of organizing the newly collected asset data, word spread quickly about UTIBS. Suddenly, UDOT was being asked by other agencies to educate them on the data-collection project, and other companies were asking for the opportunity to participate in the program. The AAA Foundation offered to work with UDOT to help improve their road-safety analysis by applying principles developed as part of their usRAP initiative. The 3M Corp. offered to assist in developing a traffic-sign-management program.

Complete virtual road system

UDOT now has a complete asset inventory of every item within the right-of-way, including exactly how much asphalt and concrete make up their state-maintained system. While that is impressive, their asset extraction process also provides the exact size and location of all pavement markings, guardrails, barriers, road signs and light fixtures. The condition and performance of bridges and pavements is integrated into these data sets. The data is collected and organized in a way that gives Burns a great sense of confidence when considering new federal performance-measure-reporting requirements.

"While we can secure the linear-referencing-system data from a number of sources," Burns said, "this data set allows us to extract any combination of condition, performance or safety data sets that could be requested on

our state-maintained portions of the National Highway System."

Another key benefit of the new system is its ability to make UDOT smarter when it comes to developing a risk approach to asset management.

"Operations and safety data combined with the ability to easily geolocate and parse out specific asset data allows us the flexibility to target investments," Burns said. "Instead of straightforward corridor-replacement programs, we are able to break out signs or guardrails and only replace based on specific condition issues.

An improved understanding of the cost/benefit of installing and maintaining various types of devices is projected to result in significant cost savings.

The planning process also will be enhanced. Thanks to UDOT's UGate, built on the Oracle

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platform, and ESRI's ArcGIS system, UDOT will be able to integrate environmental, economic, archaeological and other pertinent data sets into corridor analysis projects.

"The more we integrate the data needed to make good decisions, the better we reduce the risks associated with project planning. This allows us to streamline the development and project permitting process and avoid sensitive locations," said Frank Pisani, UDOT's GIS manager. "Showcasing these facts within UPlan creates confidence and transparency both inside and outside of UDOT that we are creating value and are good stewards of public funds."

From virtual road to real safety

UDOT's director of traffic safety, Robert Hull, has a reputation of aggressively working to maximize federal and state sources of roadway safety funds to reduce roadway fatalities. Since implementing a Towards Zero Deaths initiative in 2006, Utah traffic fatalities have dropped slightly over 24%. The traffic and safety team was one of the first to understand the value of the UTIBS initiative and is investing in the data collection and working to take full advantage of the system.

"The combination of photolog, lidar, asset extraction and road geometries gives us an excellent starting point in understanding the role of the road and traffic features in fatal crashes," said Hull. "When you layer in crash location—and local demographic data such as high schools, bars or other high-risk locations—the system starts to teach us where we need to focus. This roadway data gives us the information necessary to educate our internal UDOT teams as well as external audiences such as policy makers and law-enforcement agencies."

UDOT's traffic safety team is working with ESRI, the AAA Foundation and MRI Global to better evaluate crash data to look for specific trends.

"We are able to identify high-risk locations from a systemic standpoint and begin to build into our program effective countermeasures," said Hull.

UDOT also is beginning to explore the concept of conducting roadway safety audits from their desks using the photolog, geometry, pavement condition, safety device inventories and past crash histories. UDOT has begun work with Brigham Young University to develop statistical models that combine crash and roadway data to help prioritize countermeasure investment.

Future benefits

UDOT is planning to re-collect the network in 2014 and 2016. The asset extraction from these lidar data sets will be much simpler as algorithms are develo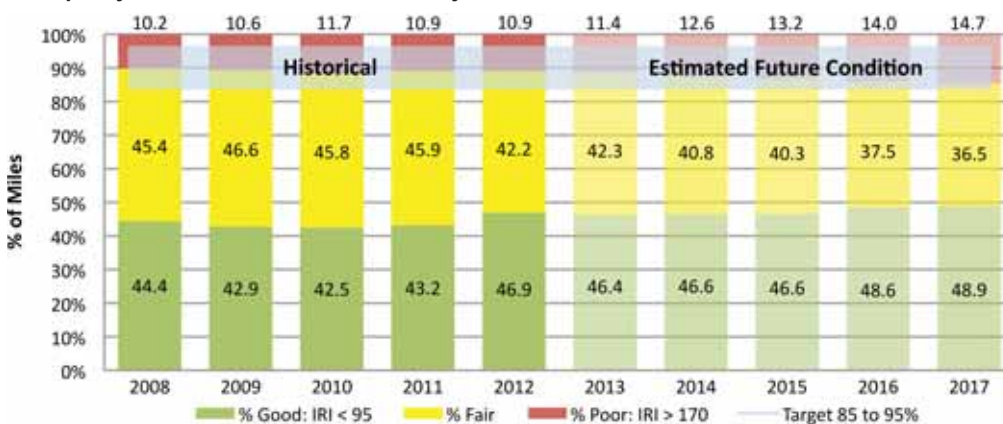ped to recognize system changes. The 2014 data collection is slated to include a sign retrore-flectivity (nighttime visibility) component. A more accurate set of lidar sensors also will be used to facilitate the use of data for virtual design. Bentley Systems and Virtual Geomatics are working to find new ways to evaluate and even adjust the data being collected to allow for design. UDOT's emphasis on tools such as lidar will likely serve as a catalyst for greater utilization of 3-D modeling in transportation construction. Three-dimensional modeling software creates a more efficient and accurate project planning, design and construction process. When the data is exported from 3-D software it can be incorporated into automated GPS machine-control technologies.

While virtual design and cutting-edge construction practices provide considerable payoffs for UDOT's asset management today, their efforts may lay the groundwork for additional game-changing technologies. An accurate lidar base map is a key component for current autonomous vehicle technologies. The 2014 lidar data collection will be accurate enough for vehicle base maps. If UDOT provides open access to this data set, the economic benefit could be considerable as technology and auto companies experiment with the network data to develop algorithms designed at creating a virtual guide rail.

As the U.S. DOT continues work on the development of performance measures designed at meeting new Congressional requirements, UDOT provides a model with the transparency and clarity intended by Congress as well as benefits that will pay dividends well beyond the life of MAP-21. Whether it is creating a 21st-century model for transportation asset management or the potential to serve as a catalyst for a new wave of vehicle technologies, it seems as if the road to the future currently runs through Utah. R&B

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For more information about this topic, check out the Safety Channel at www.roadsbridges.com.

Figure 1. Statewide highway system (5,860 miles).
Ride quality – forecasted with $188 million/yr