Introduction

Efficiencies in the Utah Department of Transportation (UDOT) often generate cost savings for the public and the Department through better utilization of resources and innovative technologies. This report contains summaries of key efficiency initiatives from State Fiscal Year 2014.

These efficiencies highlight the significant progress made during 2014 toward accomplishing the Strategic Goals of the Department. Working to achieve the Strategic Goals is how the Department fulfills its Vision of “Keeping Utah Moving” and its Mission of “Innovating transportation solutions that strengthen Utah’s economy and enhance quality of life.”

The Strategic Goals of the Department were recently updated and are shown below for both State Fiscal Years 2014 and 2015:

<table>
<thead>
<tr>
<th>Fiscal Year 2014</th>
<th>Fiscal Year 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Preserve Infrastructure</td>
<td>• Zero Crashes, Injuries and Fatalities</td>
</tr>
<tr>
<td>• Optimize Mobility</td>
<td>• Optimize Mobility</td>
</tr>
<tr>
<td>• Zero Fatalities</td>
<td>• Preserve Infrastructure</td>
</tr>
<tr>
<td>• Strengthen the Economy</td>
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This report fulfills a statutory requirement for the Department to describe the efficiencies and significant accomplishments achieved during the past year to the State Legislature. Statements of time and cost savings are best estimates at the time of document preparation. This and past annual reports are available online at www.udot.utah.gov/go/efficiencies.
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SUCCESS Framework Initiative

In his 2013 State of the State Address, Governor Herbert challenged all State of Utah agencies to become more efficient when he stated, “Our obligation to the taxpayer requires that we continue delivering outstanding results... [Our] target is to improve government operations and services by 25% (a combination of quality, cost, and throughput) throughout the next four years.”

The SUCCESS Framework is a resulting set of management principles designed to boost the quality and efficiency of government services, with the goal of delivering ever-increasing value per dollar to the citizens of the state of Utah. These tools also provide assistance in meeting the complex challenges facing government services – including increased demands, fragmentation, and reduced budgets.

The SUCCESS Framework within the Utah Department of Transportation can be viewed as consisting of three phases:

1. Department leaders identified six major systems in our business. Goals of these major systems are identified at initial meetings between the Department team and the Governor’s Office of Management and Budget (GOMB). The goals of each major system are configured into an equation known as QT/OE, which means quality throughput divided by operating expense.
2. A one-page operational improvement strategy is completed at subsequent meetings between the Department and GOMB. This improvement strategy provides a high-level process map of a system, identifies the critical resource for the system, and “what good looks like” at each point in the process.
3. The Department applies the operational excellence tools to the system as guided by the one-page improvement strategy and the measurement of resulting effects on quality throughput and operating expense.

The application of these three phases assists the Department in determining how we can best improve the value per dollar rendered to taxpayers by our services. On a monthly or annual basis, depending on the given system, the Department reports to the GOMB on efficiencies realized to date for the six major systems. Highlights of these six systems and the associated cost savings or other efficiencies are described below.
Statewide Access Management Program

**Savings:** Approximately $42,000 in annual cost savings by lowering the per-access-permit processing cost from $1,709 to $1,532 ($177 per permit).

**Efficiency:** Reduced time and labor cost to process permit applications due to updated programmatic forms, applications, website content, logo branding, performance measures, and applicant education process.

In alignment with the Department’s Strategic Goals, an effective access management program helps reduce property damage, personal injury, and vehicle or pedestrian-related fatality rates. It also improves traffic flow and circulation, which leads to less traffic congestion, lower commuter delay rates, and improved air quality for the state of Utah.

The Department’s Leadership Team paved the way towards making significant program-based achievements for access management over the past 12 months. They did this by selecting this program to participate in the Governor’s newly launched SUCCESS Framework Initiative, and by assembling a statewide multidisciplinary team of access management stakeholders.

In collaboration with the GOMB, the team successfully applied the theory-of-constraints model by developing a sound throughput operating strategy. The team also employed an interference diagram and gap analysis tools to begin identifying logical choke points within the existing program workflow. These actions led to the development of concrete strategies aimed at mitigating those program-level constraints.

The diagram below is an excerpt from the Statewide Access Management Program’s throughput operating strategy. It shows the control point occurring when the formal application review process begins. Once the control point was identified the team determined “what good looks like” for this workflow. From there, the team began implementing changes to ensure applications entering the review stage are fully completed upon arrival.
These efforts resulted in a number of achievements. Initial successes of lowering the individual unit production costs by $177 per access permit were realized by reducing time and labor costs through the use of updated programmatic forms, applications, website content, logo branding, performance measures, and the applicant education process.

The next steps in this continuous process of program improvement are focused on aligning the Department’s Online Permit System to match current forms and workflow processes. In addition, efforts are being made to integrate geographic information system (GIS) technologies that will enable end-users to visualize the statewide permitting environment in real time. Together, these efforts will serve to dramatically enhance the end-user experience, while also flattening numerous program processes into a more uniform, consistent, and efficient operating model.

Preconstruction Project Scoping

**Savings:** Savings in both time and money through avoiding the re-designing of projects.

**Efficiency:** Placed emphasis on performing a complete project scoping process in order to avoid continual changes during the design of a project, which cause costs to increase (Change Orders); 143% improvement in our quality and throughput for this system in 2014.

The goal of the Preconstruction System is to deliver a clear, accurate advertising package that meets the project goals – on time and within budget. We are improving our project delivery by focusing on our scoping process. The Department has committed to spend more time in the early phases of the projects in order to fully define a scope and schedule that meets the project goals.

The key initiative we have implemented to help us increase efficiency is the Project Definition Document (PDD).

The PDD has become the final product of the scoping process. It documents the decisions the project team has made regarding the items that will be included in the project as well as those that will not be part of the project. Approval of the Region senior staff is required prior to proceeding with the final design of the project to make sure that all...
areas of the Region are aware of the work that will be accomplished. The main benefit of this process is that the entire team is on the same page and proceeds with the same plan in mind. Prior to this, we would often see teams spend a significant amount of time reworking the design due to scope items being added at the last minute. This caused delays and potential change orders in the field due to the speed at which teams had to respond in order to advertise projects on schedule.

The diagram below is an excerpt from the Preconstruction Project Scoping throughput operating strategy. It shows the control point, or the focus of our efficiency, occurring at the project scoping phase. Once the control point was identified the team determined “what good looks like” for this workflow. From there, the team began implementing changes to ensure every project has a completed Project Definition Document with clear goals and that it is reviewed by Region senior staff.

From calendar year 2013 until August 2014, the Department has made a 143% improvement in our quality and throughput for this system.
Ports of Entry Truck Processing

**Savings:** Savings of over $3.6 million to the trucking industry using PrePass data ($8.68 per pull-in).

**Efficiency:** Truck bypasses increased from 1,256,711 in Fiscal Year 2013 to 1,674,367 in Fiscal Year 2014, or a 33% increase in trucks allowed to bypass the ports of entry (an additional 417,656 trucks).

The Department’s Motor Carrier Division plan includes several initiatives including the discontinuation of bail collection at the ports of entry (POE’s), improved availability of trucks bypassing the ports, and implementation of new mobile technology for port agents and inspectors. These activities will save a significant amount of operational cost for the State as well as time, fuel, and operational cost to private industry and emission reductions to the environment.

At the beginning of Fiscal Year 2015, the ports of entry were successful in working with local courts to discontinue the practice of bail collection for citations issued at the ports. In Fiscal Year 2014, the ports collected bail on 3,520 citations issued to motor carriers. This change is allowing our employees to concentrate efforts on other port operational duties.

With the License Plate Reader (LPR) and Optical Character Reader (OCR) technologies coming online at our interstate ports, we will be able to increase the number of truck bypasses statewide. The Drivewyze program, in addition to PrePass, will come online in December 2014 and will also increase the percent of bypasses at the interstate POE’s. The Division promotes the use of PrePass and Drivewyze by qualified carriers on its website and through industry-backed communication.

The Division has spent considerable time and effort in searching for technologies to upgrade current Motor Carrier systems and mobile solutions to improve and streamline POE operations and permit verification. Utah Interactive (UII) has identified solutions for the Division, and we are awaiting approvals from our Senior Leaders and the Utah Department of Technology Services, and funding options for this technology. This will provide a more efficient port operation for our people and decrease the time carriers are spending at the ports of entry.

The diagram below is an excerpt from the POE Truck Processing throughput operating strategy. It shows the control point, or the focus of our efficiency, occurring when the POE identifies trucks for inspection through the time they leave the port. Once the control point was identified the team determined “what good looks like” for this workflow. From there, the team began implementing changes to ensure the industry is educated on available bypass options by qualified carriers, pulling in the right trucks and researching technology for further improvements.
Snow and Ice Control

Savings: Maintenance Operations improved the efficiency of its Snow and Ice Control operation by 3.2% in Fiscal Year 2014, over the baseline average from Fiscal Year 2011 to 2013.

Efficiency: Improved Snow and Ice Control operation through a combination of actions that together produced positive benefits to both the Department and the traveling public.

Snow and Ice Control is one of the Department’s primary tasks, one that the public relies upon in order to maintain the ability to travel safely to desired destinations during and immediately following winter weather events. The Department measures its efficiency in regard to ice and snow control by examining the total cost of the operation, along with the number of labor hours for related activities, the number of hours used by snow removal equipment, and the effect of the snow removal operation on the condition of the roadway surface. Labor hours are most efficiently used when operators are actually anti-icing prior to an event or plowing snow during the event. Thus, the Department’s aim is to reduce time spent in tasks that take away from time available for the plowing operation.

The diagram below is an excerpt from the Snow and Ice Control throughput operating strategy. It shows the control point, or the focus of our efficiency, occurring when a weather event has been forecasted until the road surfaces are clear. Once the control point was identified the team determined “what good looks like” for this workflow. From there, the team began implementing changes to ensure optimal use of equipment, supplies and personnel.
In order to improve the efficiency measure for Fiscal Year 2014 from the baseline (average of Fiscal Year 2011 to 2013), a variety of important actions were taken:

- This effort included implementing new contracts for deicing salt that allowed maintenance station supervisors the ability to select the product they needed to most effectively fight each storm at the right price.
- The Regions employed better use of anti-icing and pre-wetting strategies that led to lower usage of solid salt products and better outcomes on the road.
- The Regions focused snow plan revisions on efficient movement of trucks and use of staff time to keep “dead head” time to a minimum.
- All staff was prepared through various training and preparation events to be ready for the season.
- Before the season began, care was taken to ensure that trucks were properly serviced, and ready to perform with a minimum of breakdowns during the season. More focus was placed on keeping the equipment in a state of good repair.
- The Department expanded the network of remote weather cameras by over 100 additional cameras. Also, advanced weather prediction tools were better utilized.

In addition to the actions listed above, the Department is currently undertaking an initiative to complete a comprehensive, GIS-based analysis of snow plow routes across the Wasatch Front. Further improvements for Fiscal Year 2015 are also expected due to an increase in covered salt storage.
Procurement System

**Savings:** Improved Procurement requisition quality throughput by 36.7% in Fiscal Year 2014.

**Efficiency:** Requisition process improvements through procurement training sessions, revision of policies, and development of purchasing and contract guides for end-users.

The Department’s Procurement Division tracks quality requisition throughput as a performance measure in three major purchasing categories: State Procurement, Title 72, and All Other. State Procurement requisitions are non-transportation related products or services that exceed the Department’s limited purchasing delegation. Title 72 requisitions fall under the Utah State Code giving direct procurement authority to the Department for the construction and maintenance of highways. All Other requisitions include non-transportation related products or services that fall within the Department’s limited purchasing delegation.

Requisition process improvements were made possible through implementation of the following action plan:

- Procurement training sessions held throughout all areas of the Department.
- Procurement training added to UDOT University for easier access and tracking.
- Revision of the Department’s Procurement Policy for improved clarity and information flow.
- Development of purchasing and contract guides for end-user reference and training.
- Development of a purchasing flow chart to provide a clear set of instructions to end-users.

The purpose of measuring quality requisition throughput is to track performance improvements resulting from the implementation and execution of the above action plan. The more quality requisitions, the better and faster we meet the needs of our customers and the overall vision and mission of the Department: *Keeping Utah Moving and Innovating transportation solutions that strengthen Utah’s economy and enhance quality of life.*

The diagram below is an excerpt from the Procurement Quality Requisition throughput operating strategy. It shows the control point, or the focus of our efficiency, occurring when Procurement receives the file for a procurement requisition until the time they post the bid or send it to State Purchasing. Once the control point was identified, the team determined “what good looks like” for this workflow. From there, the team began implementing changes to ensure the customer is educated on the procurement process and providing complete, accurate and timely requests so that they can spend a higher percentage of time preparing bids and executing contracts.
Heavy Duty Truck Maintenance

**Savings:** Estimated 25% increase in efficiency by the end of 2016; no measurable time or cost savings at this time, as this plan was implemented after the Fiscal Year 2014 snow season.

**Efficiency:** Equipment Operations reduced the number of tasks that mechanics can charge their time to, thus providing quality and accuracy in the data we are extracting for truck and resource availability during the snow season.

Ensuring our heavy duty trucks are properly maintained and repaired safeguards that they are available to plow snow and help maintain traction on the road surface. This directly aligns with our Zero Crashes, Injuries and Fatalities Strategic Goal.

The Department is focused on creating a “TLC Culture of Ownership” with the equipment shops in regards to heavy duty truck maintenance and devising a plan to ensure trucks and resources are available to match the snow plan expectations. Implementing this plan will allow more transparency in the effectiveness of the equipment shops to get trucks in need of attention through the repair process.
The measurement for heavy duty trucks is focused on heavy duty trucks being available to plow snow and maintain traction on the road from October 15th through May 15th. The baseline measurement is 80.6% availability. The goal of Equipment Operations management is to have 90% of our total trucks available to plow when needed.

After mapping out our current processes, we established that equipment downtime can be significantly reduced by refining internal procedures, conducting training and improving communication between the mechanic shops and the regions. We expect the results of the improvements will allow us to more accurately predict repair trends for parts procurement and get the trucks back on the road in a more efficient manner.

The diagram below is an excerpt from the Equipment Maintenance throughput operating strategy. It shows the control point, or the focus of our efficiency, occurring when preventative maintenance should happen through the repair process. Once the control point was identified the team determined “what good looks like” for this workflow. From there, the team began implementing changes to ensure equipment is getting proper preventative maintenance and, when needed, it is getting through the repair process in a timelier manner.

The next steps in this process are focused on monthly analysis of the efficiency during the snow season and developing a proposal for additional funding for aggressive replacement of our aging fleet to additionally reduce repair cost and downtime.
Report Auto Generator for Roadway “As-Builts”

**Savings**: Estimated annual labor cost savings of $250,000 as a result of the ability to automatically generate quantities of existing assets in specified roadway sections.

**Efficiency**: Reduced labor costs and increased accuracy of calculating quantities for project planning, design and construction.

Engineers in the Department’s Program Development Group have developed a new tool, called the Report Auto Generator, that helps Department designers and technicians work more efficiently. The new tool is an example of how the Department is making good use of an extensive and innovative data collection effort that gathers vital information on every state roadway asset visible from a car window.

Each year the Department designs and constructs approximately 75 preservation and rehabilitation projects. The traditional method of gathering information for the quantity sheets is for the designers to visit the project site and re-create "as-built" conditions. The time required to create this information using a surveyor’s wheel and measuring tape varies from project to project. We estimate anywhere from four to eight days per project. The Report Auto Generator automatically creates "as-builts" for specific roadway segments by linking to the Department’s feature inventory. Engineers are still required to visit the project site to verify the feature inventory accuracy but the time required to create the initial spreadsheet has been shortened to about 30 minutes.

Quantities for Concept Reports were developed in a similar fashion by a field visit with only a general description of project objectives. Creating an initial list of existing project assets prior to the field visits has shortened time to create the concept report by at least 10 hours per report. The Department completes six to ten Concept Reports per Region (four Regions) per year. Similarly, each Maintenance Station produces a list of all the assets they are responsible to maintain each year in order to accurately plan funding needs. This list is typically made by driving each road and writing down the visible assets.

The Report Auto Generator integrates asset management data from the Department’s online data repository with standard formulas for figuring material quantities. Activating the tool populates a Microsoft Excel spreadsheet. The Report Auto Generator works along with the Linear Bench, a straight line diagram tool. Both tools are accessible at the Department’s Data Portal, an online one-stop shop for geo-located business data.
Once populated, the summary sheets from the Report Auto Generator show:

- Pavement type, surface area and material amounts for granular borrow and base course.
- Barrier and post type, all sorted into standard and non-standard types.
- Signs, including location, sign type, size and any damage present.
- Pavement markings, paint amounts, messages, rumble strips and grooved-in paint.
- Hyperlinks that access previous designs that include past summary sheets and “as-built” files.
- Hyperlinks from each asset category to Roadview Explorer, an online, searchable video inventory of all state routes.

The summary sheet tables can be used to verify measurements, barrier type, roadway geometry, etc. by visiting the field, or by using Roadview Explorer on a desktop computer.

The Report Auto Generator form has been downloaded over 1,100 times since it launched in April 2014. Employee feedback indicates that quantities pulled by the Report Auto Generator are within 2% of field quantities, and that notes generated for features point out deficiencies that may have otherwise been overlooked. Users also appreciate the safety benefit of being able to verify information from the roadway shoulder or via Roadview Explorer.

The Department is in the process of an improved and expanded roadway data collection effort for 2014. As this data becomes available and we receive ongoing employee feedback, the Report Auto Generator will be improved to provide additional and more accurate data for increased employee efficiency. We anticipate annual cost savings will increase to approximately $400,000 in labor efficiency after full implementation of the tool.
Uinta Basin Rail

Savings: $2.5 million one-time savings for engineering and environmental analysis.

Efficiency: Reduced analysis schedule from a 24 to 30-month time frame to two months by utilizing existing tools developed by the Department.

Utilizing the Department’s existing GIS and data warehouse information and tools, the Department completed the engineering feasibility and environmental impact study for 26 different rail corridors in the Uinta Basin area, totaling over 4,000 miles in length. Typically, this might take between 24 and 30 months, but by deploying these state tools and technologies, this work was completed in two months. It is estimated that the analysis would have cost $3 million utilizing traditional methodologies. The Department’s engineering consultants’ level of effort during this time was approximately $500,000 for those two months utilizing the state’s tools. Subtracting the $500,000 cost from $3 million equals the $2.5 million in cost savings.

To recognize these efficiencies, the Department made strategic investments over the past several years totaling approximately $4 million to develop tools that leverage existing systems and data sources and create collaborative initiatives between other state agencies. Ongoing costs are primarily related to existing staff continuing to improve information systems and data availability. These investments are yielding significant returns not only for this project, but also for other projects and programs at varying degrees of return.

Another outcome of the Department’s efforts to streamline information use is an initiative led by the Utah Department of Environmental Quality (DEQ) titled the “Uinta Basin Collaborative”. This formal Collaborative between ten different state agencies and offices is advancing the understanding and identifying the needs to organize information and systems at a statewide level. This Collaborative is currently finding ways to achieve permitting efficiencies, air quality monitoring, mapping and environmental analysis in the Uinta Basin.

Below is another example of the output from the engineering and environmental analysis tools.
Outdoor Advertising Control Map

**Savings:** Estimated $82,000 in annual cost savings through the development and implementation of a national-award-winning GIS map.

**Efficiency:** Streamlined a labor-intensive research process that required hours into one that now takes only seconds to arrive at an informed conclusion on billboard inventory control using a GIS map.

The Department’s Outdoor Advertising Control (OAC) Program is in its 46th year of operation. Its origins track back to 1968 when the Utah State Legislature enacted the Utah-Federal Agreement for the Control of Outdoor Advertising (Utah Administrative Code, Rule R933-5) in response to the Federal Highway Beautification Act of 1965. To help with required regulation, the Department recently designed and implemented an interactive GIS map linked to the Department’s billboard inventory control system.

The passage of the Federal Highway Beautification Act was one of the first national environmental initiatives aimed at reducing scenic blight associated with the uncontrolled proliferation of billboard advertising across the nation. The Act requires the regulation of all off-premise outdoor advertising on the National Highway System (NHS), Federal-Aid Primary (FAP) routes as identified in 1991, and scenic byways on the NHS or FAP. Failure to maintain “effective control” of outdoor advertising under the Act can result in a 10% penalty deduction being applied to the state’s overall federal highway transportation funding. In Utah, such a penalty is currently estimated to be in the tens of millions of dollars each year. At the same time, outdoor advertising is linked to supporting the economic vitality and development-related interests of small and large businesses alike. In that sense, the Act is intended to strike a fair balance between the interests of the public and those of the business community on which the public relies for delivery of goods and services.
For decades the Department’s OAC Program struggled to consistently identify which routes in the state required billboard control. Additionally, the Department had an equal challenge of identifying its existing permitted billboard inventory on these controlled routes. In the past, the identification process required the comparison of 1) an NHS map, 2) an FAP map, 3) a Scenic Byway Map, 4) a Milepost Marker map, 5) the review of a spreadsheet, and 6) usually a phone call to the Regional Office to determine the answer. This process could take as much as a business day or more to complete if the answer was not immediately clear, and direct contact with the Region Permit Officer was required to make a definitive determination. This also led to a lack of consensus over which routes were actually required to be controlled across the state. Additionally, it led to an almost complete lack of regulatory transparency, because the Department could not easily identify the controlled routes, nor the permitted billboard structures located on those routes.

By early 2012 the Department recognized the major programmatic deficiencies being created by a lack of integrated geospatial data. The OAC Program administrators then partnered with the Department’s GIS team and the Department of Technology Services. The mission was to begin designing an interactive GIS map that was linked to the Department’s billboard inventory control system and that could display all associated geospatial data in real time. Within 12 months the GIS team produced a revolutionary working model that, for the first time ever, allowed visual access to all of the Department’s controlled routes and permitted billboard inventory in a single-source location.

In the span of a little less than a year the Department went from having a deficient geospatial system, to one of the best among the 45 states that have similar OAC programs. In 2014, the Department was honored with a national award for the development of this innovative GIS map from the National Alliance of Highway Beautification Agencies (NAHBA). It was one of only three such honors awarded by NAHBA in all of 2014. It is also the first national award bestowed on the Department for its OAC Program after 46 years of program operations.
The following table provides a quick snapshot of the overall projected value created through the OAC Map and the reduced Department staff time needed for the listed activities. More details are available.

<table>
<thead>
<tr>
<th>Benefited Activity</th>
<th>Estimated Cost Savings</th>
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<tbody>
<tr>
<td>GRAMA Requests</td>
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<td>Permit Research and Processing</td>
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<td>Permit Plate Enforcement</td>
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<tr>
<td>Quality Control/Assurance</td>
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<td><strong>Total Annual Savings</strong></td>
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<td><strong>5-Year Projected Cost Savings</strong></td>
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</tbody>
</table>

Finally, the OAC Map has had an additional and unexpected benefit for the billboard industry. Not only has it helped them proactively clean up their own permitting records, which is a mutual benefit, but it has also aided them in visually understanding the geographic dispersion of permitted billboards across the state. This, in turn, has enabled industry stakeholders to perform more thorough market analysis and has led to an increase in billboard applications as viable future sign locations are much easier to identify.

**Automated Queue Warning Detection System**

**Savings:** Using a relatively low-cost system, crashes were prevented in the off-ramp area of the construction work zone.

**Efficiency:** Prevention of crashes and addressing concerns of traffic backing onto the interstate, using an automated queue warning system on the Redwood Road, Interstate 80 to 1000 North Project.

One of the biggest challenges on the Redwood Road, Interstate 80 (I-80) to 1000 North Project was maintaining traffic through the work zone while also maintaining side-street and business access. This issue was complicated by the high number of large trucks in the area. These trucks not only utilized a significant amount of available queue space on the ramps, they also took more time to climb the incline at the interchange before clearing the signal. These factors required significant coordination to keep traffic moving.

The contractor and construction crew worked closely with the Department’s Traffic Signal Maintenance group to split phase the traffic signals and move detection zones to accommodate traffic through the work zone. The project team also worked closely with the Traffic Signals Desk at the Department’s Traffic Operations Center (TOC) to make adjustments to signal timing as the work zone configuration changed. From a traffic safety perspective, the Department’s top priority was to minimize queuing
(lining up of vehicles) on the westbound I-80 ramp and to prevent stopped traffic on mainline I-80. Despite the team’s best efforts, traffic occasionally backed up onto mainline I-80 while waiting to exit at Redwood Road.

To help address this queuing problem, the crew worked with the Department’s Region Two Traffic and Safety group and the Project Manager to process a $10,000 change order to provide an Automated Queue Warning Detection System and installed it on the I-80 westbound off-ramp to Redwood Road. With this system, the occupancy rate was monitored near the gore point (beginning) of the off-ramp. When the system detected stopped cars at this location, a warning message was activated at a variable message sign (VMS) upstream of the off-ramp alerting motorists of “STOPPED TRAFFIC AHEAD” and advising them to “PREPARE TO STOP.”

A subcontracted vendor (Ver-Mac) installed a radar sensor, cellular modem and solar panel on a highway lighting pole near the bottom of the off-ramp. They also placed a VMS equipped with a cellular modem upstream of the off-ramp. When the vendor’s software system (JamLogic) detected an occupancy rate greater than 10% at this location, a message was activated at the VMS alerting travelers to the stopped condition ahead. Once the queued traffic had dissipated, the VMS message was automatically turned off and remained off until ramp queuing was detected again.

In addition to the VMS message activating when a queue was detected, email messages were also sent to the TOC Operators, the Signal Timing Engineer and the Resident Engineer alerting them to the situation. When possible, adjustments were made to the signal timing to help clear the ramp traffic.

As a result of this installation and coordination, the project staff is not aware of any accidents at this location after the automated queue warning system was installed.

Typically, the system was activated 10 times each day throughout the week, or an average of 13.4 times on weekdays. Even during low traffic volumes, just a few long trucks on the ramp could back up traffic and activate the system. While the system was live, the queue warning messages were displayed 256 times for a total of 2,327 minutes. The average display time was 9 minutes. The maximum display time was 56 minutes (on August 23 starting
The Automated Queue Warning Detection System was a valuable addition to our “tool box” for managing traffic issues in the construction work zone on the Redwood Road project. In the future, other projects will benefit from this technology to help address traffic control and queuing issues within construction work zones.

Cement-Treated Asphalt Base

**Savings:** Approximately $500,000 from the use of recycled pavement material on one project.

**Efficiency:** Development and use of a specification which saves project time and cost, and allows for the use of on-site recycled materials while reducing the number of trucks hauling material.

The existing asphalt pavement on I-80 from Silver Creek to Wanship was severely deteriorated and in need of reconstruction. Poor drainage and ground water from the many springs through the canyon had damaged the existing asphalt pavement. It was determined the best treatment was to reconstruct the roadway with concrete pavement. During the pavement design process, the Department looked at several options for the base material below the concrete.

A specification was developed and used on the project to recycle the existing asphalt pavement in place, combine this with cement powder, shape the treated material, and then compact the material. The end product is a stable base material for the new concrete pavement. This saves time and money over traditional methods and reduces wear on the pavements near the project by reducing the number of haul trucks importing and exporting material to the project.

The process used for constructing the cement-treated asphalt base was as follows:

- The asphalt pavement was milled a minimum of four inches deep, leaving the material on site.
- The milled material was graded to the approximate cross slope to make the necessary superelevation corrections in the curves to improve safety.
- Portland cement powder was then added to the milled material, mixed with water, graded to finish...
grade, and then compacted.

- After compaction, a prime coat was applied to the surface to aid in curing.
- Construction traffic was allowed on the material after three days, and the material was fully cured, ready for the concrete overlay, in seven days.

The recycled asphalt base saved $1.40 per square yard over the asphalt overlay option. The recycled material will be less susceptible to water damage than the asphalt base, thus providing for a longer service life. The process reduced the concrete overlay thickness by a couple of inches, saving shouldering material. Also, the 100% use of recycled material allowed for the material on the low side of the curves to be moved to the high side so as to increase the cross slope. These benefits are in addition to approximately $500,000 in cost savings on this project.

The use of the new specification allowed the Department to recycle the existing deteriorated asphalt pavement into a stable base for concrete pavement. This new process will provide a longer-lasting, more cost-effective pavement section on this project, and become a tool for potential savings for future projects.
Citizen Reporter Program

**Savings:** Approximately $250,000 annually from the reduced need for road weather instrumentation, and efficiencies in storm forecasting.

**Efficiency:** Crowd-sourcing with citizens who contribute to the quantity, quality and timeliness of traveler information, especially in rural areas.

Large, mostly rural states, like Utah, struggle to provide statewide, current road conditions to travelers. The Department relies heavily on observations by its snow plow drivers, but heavy workloads during storms limit their availability to update road weather reports. While understandable, this tends to happen at the worst time – in the midst of a storm. The Department’s staff meteorologists attempt to supplement the observations of plow drivers, but they can only do so for road segments with instrumentation, and they do not have eyes on the road to verify their interpretations. These realities often mean that the Department cannot provide current road weather information because we simply do not have it. As a result, data is sometimes out-of-date.

The Department’s new Citizen Reporter Program enlists trained volunteers to report on road weather conditions along specific roadway segments across Utah. These citizen reports supplement eyewitness reports generated by the Department plow crews and forecasts by Department meteorologists. Current volunteers include private citizens, Department employees (plow drivers and others), law enforcement, and truck drivers. Citizen Reporters are trained yearly on what to report and how to provide information accurately and safely. Citizen Reporters submit their data through a mobile application.

Incoming reports are used by the Department meteorologists and plow crews to assess the condition of the roadway. All reports are also visible on the UDOT Traffic mobile app and website and help the public plan their travel.

The program was successfully pilot tested during the 2012–2013 winter season, using less than 100 Department-only volunteer reporters. The winter of 2013–2014 saw the pool of reporters broaden to the general public and the total number of reporters surge to 500. We expect this number of reporters to grow to over 2,000 for the upcoming 2014-2015 season.
For a very low cost, the Department created a conduit to accept data from trained citizens who are observing rural routes. The Citizen Reporter Program has the potential to exponentially increase the number of reports received on each road segment by giving the public the ability to report their observations. For the 2013-2014 winter season, the Citizen Reporter program contributed over 1,100 reports, covering 143 of 145 road segments. We expect this number to increase significantly next winter. An audit of incoming reports concluded that the accuracy of citizen reports exceeded 99%.

**Real-Time Winter Road Weather Index Performance Measurement**

**Savings:** Estimated $1 million annually from reduced materials, labor costs, and economic disruption.  
**Efficiency:** Real-time and post-storm performance measurement for effective snow removal planning, optimized use of materials, and efficiencies in labor.

The Department’s Winter Road Weather Index (WRWI) is a real-time tool used for during-storm and post-storm evaluations. This new capability provides benefits to the Department in several ways. Department Maintenance forces and meteorologists use it to monitor and evaluate storm intensity, the accumulation of snow on the roadway surface, and the effectiveness of snow removal efforts. It allows the Department to evaluate snow removal plans, staffing, resource allocation, and material usage. The WRWI allows the Department to communicate more effectively with motorists during and in advance of winter storms. Accurate WRWI information has also become an integral part of winter traffic control room operations.

The WRWI is a performance measure developed by the Department in collaboration between Central Maintenance, the Regional Offices, and the Traffic Management Division. It is unique — no other agency has the ability to monitor snowfall and the effectiveness of snow removal efforts in real time. A successful pilot deployment of the WRWI occurred for the winter of 2013-2014. Applying lessons learned, deployment was then expanded statewide.

WRWI data comes from specialized equipment installed on Road Weather Information System (RWIS) units or from in-pavement sensors adjacent to the RWIS. In 2013, the Department had 16 RWIS sites across the state gathering WRWI data. In 2014, the program was expanded to 71 of the Department’s 80 statewide RWIS sites.

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The WRWI gathers and factors the following values:

- Precipitation occurrence
- Road temperature
- Wind speed
- Road condition and coefficient of friction (dry, slush, ice, snow)
- Air temperature and humidity
- Visibility (combined with the precipitation occurrence to differentiate fog from snow)

A WRWI value greater than 1.0 indicates that the storm is rapid and intense and the Department’s assets may be overwhelmed. A value less than 1.0 indicates that roads will be maintainable with adequate mitigation resources.

It is understood that mitigation techniques change as the storm changes. The value of 1.0 is somewhat subjective and will continue to be evaluated. As evaluation continues, the Department is already realizing savings in time and money through the WRWI, with improved snow removal planning, optimized use of materials, and efficiencies in labor.

The figure on the next page shows the WRWI for I-80 in Parley's Canyon during the winter storm on December 3, 2013. This was a particularly strong storm with heavy snowfall that impacted both the AM and PM commutes. In the figure the red line indicates WRWI value and the green line indicates snowfall rate. Note that the WRWI value remained elevated despite a decreasing snowfall rate. This is a result of cold road temperatures (less than 20 degrees F), adding more challenge to the snow mitigation process.
I-80 @ Parley’s Summit
Variable Speed Limit in Parley’s Canyon

**Savings:** Estimated $100,000 in 2014 from reduction in crashes on I-80.

**Efficiency:** Overall improved safety of I-80 through Parley’s Canyon with variable speed limits, allowing changes in the posted speed limit in response to road conditions, weather, or driver behavior.

The Department has a new tool to enhance driver safety on I-80, one of the most heavily-traveled roads in the state. On January 8, 2014, a variable speed limit (VSL) system was activated along I-80 in Parley’s Canyon. The new VSL system is remotely controlled by traffic engineers to maintain safe and consistent traffic speeds in inclement weather conditions.

The Parley’s Canyon VSL project was developed jointly by the Department and the Utah Highway Patrol. The speed limits posted on these signs are not advisory speeds, but regulatory speed limits. The project consists of 15 signs – eight eastbound and seven westbound – located between the mouth of the canyon and Jeremy Ranch. All VSL signs are equipped with LED display screens that allow the Department to remotely change the displayed speed limits. Adjustments in the posted speed limit are made to improve driver safety during adverse road conditions.

The variable speed limit signs in Parley’s Canyon are divided into four zones: two eastbound and two westbound, separated at Mountain Dell/Lambs Canyon. When a speed limit is changed for a specific zone, the new speed limit is immediately displayed on all signs within the zone. These zones were created to match observed weather patterns and speeds in the canyon.
Each sign is connected to the Department’s Advanced Traffic Management System via fiber optic cable, and the VSL system is controlled remotely via web-based interface. This website aggregates information from all the Department’s traffic speed detectors, road weather information sensors, and cameras within the VSL corridor, as well as the current speeds being displayed by the VSL signs. The website also collects information from the Department’s weather group and notes from traffic operators. The website allows engineers to remotely monitor conditions and make speed limit changes in coordination with the Department’s TOC Control Room. For documentation purposes, the website also logs all changes to speed limits and the road conditions at the time of the speed limit change.

The speed limits are set based on weather conditions and the observed speeds on the roadway. The intent of the variable speed limit system is to reduce the variation in speeds between the slow and the fast vehicles in the corridor and thus increase safety. In general, speed limits are based on the speeds observed on the road – that is, what average drivers are actually experiencing. In dry weather, we do not allow highly capable vehicles (sports cars) to greatly exceed the speed typical vehicles can safely achieve. We would also not allow highly capable vehicles (all-wheel drive with studded snow tires) to do the same in snow. It is estimated that the Variable Speed Limits in Parley’s Canyon will result in a reduction of over 16 accidents per year on this section of I-80. The cost savings from these 16 accidents is estimated to be over $100,000 annually.

An additional benefit of the VSL is the ability to use the system to replace construction speed limit signs when the area is under active construction. This past year this area of I-80 was under construction with a pavement rehabilitation project. The project was able to save time and money from having the contractor set up and take down multiple static signs during construction. The VSL was used to post the construction speed limit in the areas that were under construction.

The new VSL corridor in Parley’s Canyon provides an opportunity to enhance driver safety and optimize mobility along I-80, one of the most important corridors in the state. These signs allow TOC operators and traffic engineers to normalize the flow of traffic in inclement weather, or in other situations (construction, crashes, lane restrictions, debris, etc.) where a temporary speed reduction is helpful.

The system is designed is to balance the need to be deliberate when changing speed limits with the need to respond to conditions as quickly as possible. Traffic engineers are committed to looking at data (road conditions, speed, weather, etc.) in the VSL corridor to make responsible and responsive decisions that are supported by the data and are in the best interest of the traveling public.
Snow Fencing Efficiencies

**Savings:** Approximately $40,000 in 2014 in Regions One and Three from reduced manpower, materials and equipment, and overall snow plow effort.

**Efficiency:** Reduced time required for snow removal, reduced need for plowing when the wind blows, and improved safety and mobility of the roadway for winter drivers.

Snow fence has been used for many years by the Department in several areas of the state. It helps to reduce the amount of snow that blows onto the roadway. This improves safety and mobility for vehicles, reduces the need for frequent snow plowing and the associated plow driver overtime, reduces the wear on plow trucks and blades and the amount of fuel and salt needed, and allows maintenance forces to spend more time on other roads and other duties. Over the past year the Department has seen significant benefits from recent, innovative snow fence installations in two areas of the state.

The Department’s Region One installed snow fence along State Route 142 (SR-142) in Clarkston, and this has reduced windblown snow. This prevents the Department from having to send trucks to Clarkston each time the wind blows and there is snow on the ground. The snow fence in this area was made possible through an agreement between the Department and property owners adjacent to SR-142. The property owners see this as a benefit, as the moisture from drifted snow remains on their farm land. They allow the Department to install the fence in the fall and remove it in the spring. The snow fence has been very effective in dropping the snow behind the fence before it can reach SR-142. The Clarkston area averaged 21 snow storms per year over the past three years. In 2014 we saved approximately three snow plow trips per storm (in between storms) due to the reduced amount of drifting snow on the roadway. This equates to total operational cost savings of approximately $22,000 in one year for this area.

The Department’s Region Three installed snow fence on State Routes 73, 85, and 92 in areas that have a history of blowing and drifting snow. This was done to improve safety and mobility for winter drivers and to reduce the required maintenance costs and effort to keep the roadway clear of snow. Region Three limited the length of the fence on SR-85 and SR-92 to see if it would be effective, since the fence is closer to the road than usual for normal snow fencing. The snow fence has worked very well and has reduced the amount of snow getting on the roadway.

Each of these areas in Region Three is adjacent to open fields where the wind blows the snow off of the fields and across the road. Previously, plows were often called out on sunny days to remove snow that the wind had blown across the road. The snow fence has almost eliminated the drifting snow on the
road which reduces our overall snow removal effort and associated costs. Region Three is currently looking to add more snow fencing in the near future on SR-73.

The main savings from the new snow fences in Region Three comes from reducing the number of snow plow trips and the length of these trips on windy days. On average there are about 18 snow storms a year in Region Three, and we had been typically called out about one additional time between storms for drifting snow. We estimate the 2014 cost savings in material, labor, and equipment to be $18,000 based on the reduced number of trips, using six trucks and drivers, to the three locations.