

2019 UDOT RESEARCH PROBLEM STATEMENT

*** Problem statement deadline is Feb. 6, 2019. Submit statements to UTRAC@utah.gov. ***

Title: Analysis of the Effectiveness of DSRC on Snow Plow Operations in Utah

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Select **ONE** Subject Area Materials/Pavements Maintenance Traffic Mgmt/Safety Structures/Geotech
 Planning Perf Mgmt/Data Analytics Public Transportation Other

1. Describe the problem to be addressed:

Transit Signal Priority (TSP) is a general term for a set of operational improvements that use technology to provide operational benefits for transit or other vehicle types (e.g., snow plows) by holding green lights longer or shortening red lights (1). The Utah Department of Transportation (UDOT), working together with the Utah Transit Authority (UTA), recently completed a study evaluating the benefits of TSP using Dedicated Short Range Communications (DSRC) on UTA buses along Redwood Road between 400 South and 8020 South in Salt Lake County (2). UTA bus route 217 served as the test section for this analysis with Avenue Consultants the main contractor of this evaluation task. The 11-mile test section on Redwood Road carries annual daily traffic (ADT) of 18,000 to 40,000 vehicles per day (vpd). It is a UDOT-owned corridor and crosses 35 signalized intersections and two light-rail crossings. The test stretch is lined with a variety of land uses, including commercial/retail establishments, residential areas, and educational institutions (2). The goal of the TSP project was to increase reliability of Route 217 buses from 86% to 94% (2). An application software called the Multi-modal Intelligent Traffic Signal System (MMITSS-AZ) developed by Dr. Larry Head of the University of Arizona is used to request TSP activations. The software's objective is to balance priority and preemption requests from various modes. The traffic analysis conducted by Avenue Consultants was developed to measure system effectiveness and impact on both UTA buses and general traffic using the data from Route 217 buses equipped with DSRC communication system devices and signal controller event data (2). Granting TSP based on a 5-minute lateness threshold has since been shown to improve bus reliability for equipped buses on Route 217 by 3-6% with little effect on general traffic.

Due to the success of utilizing TSP on UTA buses, UDOT is currently in the process of outfitting snow plows with the same DSRC technology to utilize signal preemption for snow plows. Currently UDOT employees 481 full-time plow drivers while utilizing an additional 80 construction staff and seasonal employees to operate the fleet of 508 snow plow trucks, 11 self-propelled snow blowers, and 13 TowPlows statewide. This team is responsible for clearing the snow in the approximately 25 winter storms annually on the entire network of state-owned roadways (3). It is theorized that if the snow plows can receive signal preemption on key routes, the roads will be cleared of snow and ice sooner and there will be anticipated operational and safety benefits on these corridors. Initially, UDOT is planning to outfit snow plows with DSRC technology on four corridors in the Salt Lake valley.

There are several metrics that can be considered when identifying the benefits to the snow plows using the DSRC signal preemption system. These benefits include reduced time for snow removal, more effective removal of the snow (as the faster the plows travel, the further the snow can be thrown), reduced crashes on corridors where snow is removed more efficiently through the use of DSRC, and an overall improvement in the quality of snow removal. The purpose of this research is to evaluate the effectiveness of snow removal on corridors with and without DSRC signal preemption implementation. The research team will work closely with UDOT Operations, Maintenance, and Traffic & Safety to identify all possible measures of effectiveness (MOEs) and to collect these MOEs during snow events in the 2019-2020 winter season. Corridors with DSRC will be compared to similar corridors without DSRC to make a comparison between the two routes.

References:

1. Transit Wiki. "Transit Signal Priority (TSP)." <[https://www.transitwiki.org/TransitWiki/index.php/Transit_signal_priority_\(TSP\)](https://www.transitwiki.org/TransitWiki/index.php/Transit_signal_priority_(TSP))>. Accessed January 29, 2019.
2. Leonard, B. D. "Installing DSRC Systems for Vehicle to Infrastructure Applications." Utah Department of Transportation, 2017.
3. Utah Department of Transportation "UDOT Snow Removal." <<https://www.udot.utah.gov/main/?p=100:pg:0::1:T,V:2,70433>>. Accessed January 29, 2019.

2. Write the project objective (25 words or less):

Evaluate the range of benefits and impact expected using DSRC-equipped snow plows as compared to snow plows operating on similar corridors without signal preemption benefits.

3. Explain why this research is important:

(In response, consider addressing specific UDOT goals, applicability in Utah or other states, etc.)

Use of a DSRC system is one-step forward for wider implementation of vehicle to infrastructure (V2I) systems on UDOT's transportation network. The proposed study will add to the field demonstration program currently being conducted using UTA buses and continue to allow UDOT to identify the benefits of providing V2I communications throughout the network.

4. List the major tasks:

1. Kickoff meeting to develop a project scope of work and cost estimates.
2. Conduct a literature review.
3. Develop a design of experiment to collect data on equipped and non-equipped corridors.
4. Carry out the design of experiment and collect data on the benefits of signal preemption for snow plows using the MOEs determined during Task 3.
5. Conduct statistical analyses on benefits to snow removal and safety.
6. Develop DSRC snow plow implementation recommendations.
7. Report results to UDOT in the form of a written report.

5. List the expected deliverables (reports, manual, specification, design method, training, etc.):

1. Engineering report documenting the literature review and research results and technical publications in peer-reviewed journals.
2. Results of the experiment that will provide the range of benefits to be expected by snow plows utilizing the DSRC and signal preemption implementation.

6. Describe how the research results will be implemented:

(In response, consider addressing UDOT leader support, process or standard improvement, etc.)

This study can be implemented by UDOT Maintenance in conjunction with UDOT Operations in making decisions on the use of DSRC equipped snow plows throughout the urban areas.

**7. Requested from UDOT: \$70,000
(or UTA for Public Transportation)**

Other/Matching Funds: \$

Total Cost: \$70,000

8. Outline the proposed schedule, including start and major event dates:

It is recommended that this project begin in later summer or early Fall 2019 with the initial tasks of the project scope of work and detailed estimate, followed with the literature review. It will be important to have all of the snow plows equipped and ready for use prior to the 2019-2020 snow season. It is anticipated that the project would take 16-18 months, including 2-month final report review time.