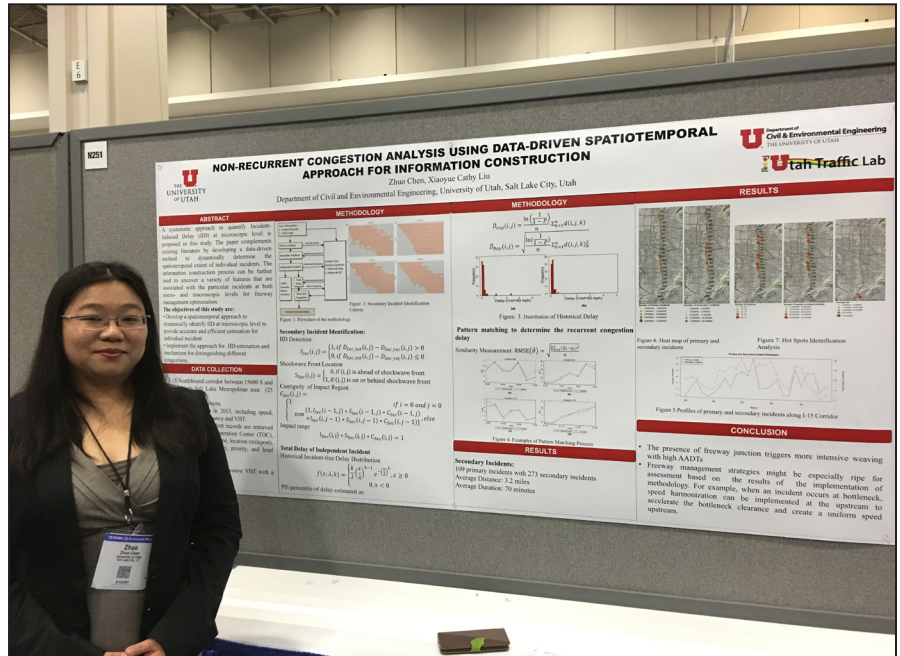


# MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 18-350 (project 494) | June 2018

## Statistical Analysis and Sampling Standards for Maintenance Management Quality Assurance (MMQA)



### the ISSUE

A sustainable transportation system relies heavily on the preservation and maintenance of highway assets to ensure and improve its functionality. The adoption of performance-based transportation management has resulted in a need for a streamlined process to make transportation investment decisions on the basis of asset performance. Accurate reporting of asset condition is critical to maintenance planning to help identify where and when assets must be reconstructed or replaced.

### the RESEARCH

An optimal maintenance program has always been focused on refining maintenance activities so that limited resources can be effectively utilized. The ability to accurately and efficiently report maintenance conditions is largely determined by data availability. Yet collecting such information can be very demanding in terms of the resources, personnel, and time required. It is thus desirable to collect asset condition data on a sampling basis rather than on the entire asset inventory. Pertaining to maintenance management, the primary goal of sampling is to successfully estimate the overall level of maintenance (LOM) at state, region, and station levels to assist with budgeting and resource allocation. To fill this gap, this project presents a systematic approach for developing a sampling scheme customized to maintenance activities. The proposed method addresses how much and where the agencies need to collect asset data with the maximum information retained for LOM estimation. The method integrates Fisher information with a spatial sampling technique that can be customized based on local agencies' requirements, such as station balanced, spatially balanced, or functional class based. These requirements are rooted in the very fundamentals of maintenance management.



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Statistical Analysis and  
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## the **FINDINGS**

The sampling framework was showcased via an application of Signage Repair and Replace database maintained by the UDOT. The sampling method was enhanced based on generalized random-tessellation stratified (GRTS) design by tailoring it to the maintenance setting. Four sampling methods that might be tempered to various needs were implemented, including GRTS sampling with equal segment weight, GRTS sampling weighted by signage, spatially-balanced sampling with equal segment weight, and spatially-balanced sampling weighted by signage. Comparing with simple random sampling method that is widely used by agencies across the country, both GRTS sampling with equal segment weight and spatially balanced with equal segment weight methods demonstrate better performance with much lower average similarity score.

## the **IMPACT**

The proposed framework lays a strong theoretical foundation for the maintenance asset sampling based on the customized requirements/needs for local agencies and is effective in estimating LOM at state, region, and station levels for budget allocation. The proposed method represents a potentially useful contribution that can be easily adoptable to any agency for optimal maintenance management.

For more information on this project, download the entire report at <http://www.ugpti.org/resources/reports/details.php?id=907>

For more information or additional copies, visit the Web site at [www.mountain-plains.org](http://www.mountain-plains.org), call (701) 231-7767 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.



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