UTC Project Information

Project Title	MPC 444 – Data-driven Freeway Performance Evaluation for Project Prioritization and Decision Making
University	University of Utah
Principal Investigator	Xiaoyue Cathy Liu
PI Contact Information	Department of Civil and Environmental Engineering University of Utah 110 Central Campus Drive, 2137 MCE Salt Lake City, UT 84112 Phone: (801) 587-8858 Email: cathy.liu@utah.edu
Funding Agencies	USDOT, Research and Innovative Technology Administration
Agency ID or Contract Number	DTRT12-G-UTC08
Project Cost	$60,000
Start and End Dates	January 1, 2013- December 31, 2013
Project Duration	1 Year
Brief Description of Research Project	According to the 2012 Urban Mobility Report, urban congestion costs about $12.1 billion dollars and a total of 5.52 billion-hour delay in 2011 (Shrank et al., 2012). Congestion has surely been growing over the past years. Transportation agencies are therefore actively seeking for ways to better monitor the traffic, identify bottlenecks, and respond efficiently and effectively to incidents. From operations perspective, using a set of meaningful performance measures to obtain comprehensive assessment of the roadway system is one of the most effective solutions for congestion management. It is also critical to decision making. The Moving Ahead for Progress in the 21st Century Act (MAP-21) establishes performance-based transportation program to guide the transportation capital investment and development. It thus enables the need to carry out a performance-based approach in evaluating the transportation system. Freeway networks play a very critical role in providing accessibility to a multitude of resources and serves as the backbone of a region's economic vitality. It is also the primary focus of operations agencies. Meanwhile, social and economic needs continue to shape the freeway network in turn with the rapid advancement of technology. It is therefore imperative to develop a data-driven freeway performance assessment framework that is able to link the performance measures with investment decisions. Freeway performance measures is oftentimes considered in three dimensions: temporal aspects, spatial details, and source of congestion

(Cambridge Systematics, 2006). Attention will be paid differently depending on the emphasis of specific agencies. For example, senior leader would look at the performance from a holistic view to obtain the overall freeway network conditions. Traffic engineers may need to provide instantaneous operation decision based on the source of congestion, and time of day situation. Transportation planners might consider development plans for alleviating congestion bottlenecks that are most critical to the entire network. In order to provide comprehensive and useful information to transportation agencies, the performance measures should be developed incorporating the three dimensions mentioned above, as well as to effectively describe the roadway condition to support investment decisions. There is also a growing recognition in the transportation profession in the recent years that performance measures should be viewed from both facility perspective for monitoring and management purposes and user perspective for customer experiences. To address this issue, performance measures need to be focused on both congestion (facility perspective) and mobility (user perspective) of the freeways.

In the meantime, freeway performance measures would not be possibly developed without the utilization of technology and the support of mass amount of data collected from multiple sources and jurisdictions. Utah Performance Measurement System (PeMS) is a freeway performance measurement system developed by Utah Department of Transportation (UDOT). It contains rich pool of information about traffic data and provides an excellent platform to both transportation practitioners and researchers. The system integrates various traffic data sources including traffic detectors, incident logs, vehicle classification data, and roadway inventory, etc. These traffic data have been automatically collected and archived and real-time information is updated from over 28,000 detectors (Iteris, 2013). The PeMS system offers valuable information for developing useful performance metrics for decision making purposes. Meaningful performance metrics should be able to best describe the freeway traffic conditions from a variety of perspective and effectively answer questions as how reliable the current system is operating, how to quantify congestion, and how to incorporate the congestion/reliability information into planning process, etc.

Research Objectives:
The objective of this project is to develop a set of performance metrics that can be incorporated into operational management and planning process for investment decisions. The performance metrics will be based on the traffic data support from PeMS and their spatial and temporal effect will be illustrated on a Geographic Information System (GIS)-based platform. The project also strives to provide linkage between performance measures and decision making by using interpretative indicators and GIS-enabled methods to inform decisions.

Describe Implementation of Research Outcomes (or why not implemented) Place Any Photos Here	Congestion Frequency is presented as the measurement of performance reliability. We identified the hotspots on the I-15 corridor in Salt Lake City during morning and evening peak hours during May to August 2013. The IID is not only determined by the severity of incident, but also dependent on the location and time of day. The locations with high incident frequency generally suffer from higher IID than the locations with low incident frequency. The results of adverse weather's impact analysis indicate that under the influence of adverse weather travel demand decreases. This is the case for more than 50% of the scenarios. We conclude that in 2013, the adverse weather forecasting system succeeded in alerting the public and preventing severe traffic breakdowns. As roadway condition gets worse, the traffic demand shows a more significant reduction pattern.
Impacts/Benefits of Implementation (actual, not anticipated)	The data-driven performance-based approach presented in this study is effective in quantitatively evaluating the freeway mobility/reliability, incident and adverse weather impact. The objectives of this project align well with the goal set forth by MAP-21, which is to establish performance-based transportation programs to guide the transportation capital investment and development. The algorithm developed can be integrated into the operational analysis to identify hotspots along freeway corridors, and assist with project prioritization and decision making.
Web Links • Reports • Project Website	http://www.ugpti.org/resources/reports/details.php?id=863