# Selecting the Most Feasible Construction Phasing Plans for Urban Highway Rehabilitation Projects

**Project Number:**
19ITSLSU07

**Start Date:**
08/15/2019

**End Date:**
02/15/2021

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**Lead Institution:**
Texas A&M University

**Funds Requested to UTC:**
$50,000

**Funding Source(s):**
Tran-SET
Texas A&M University
Louisiana State University

**Total Project Cost:**
$150,000

*Creating a unified data-driven computerized model for autonomously predicting the levels of mobility disruption caused by the presence of a critical work zone under arbitrary and user-defined "what-if" rehabilitation scenariosto*

Approximately one-fifth of the U.S. highway system is under construction, resulting in more than 3,000 construction work zones (CWZ) across cities and states. Since CWZ disrupt traffic flow, daily commuters, and business interests are facing a pressing need to improve mobility around work zones. The primary problem is a lack of standardized methods and analytical tools for proactively assessing the level of mobility disruption that is caused by a CWZ. To tackle this immediate concern, the main objective of this study is to create and test a novel data-driven decision-support model that predicts the level of mobility disruption of a CWZ under arbitrary and user-defined construction and lane closure alternatives. This aim will be achieved by conducting a three-stage methodology that articulates a new spatiotemporal big-data modeling framework where the level of mobility disruption is assessed, and the model's prediction accuracy fused from a machine-learning algorithm is validated. The central hypothesis is that use of machine-learning techniques will inform the development of reliable mobility indicators for use in selecting the most feasible construction phasing plans. The proposed decision-support system will provide a theoretical basis for comparatively analyzing what-if lane closure scenarios of critical highway projects in urban corridors.

## Problem Statement

Delays and rerouting due to U.S. highway rehabilitation projects account for the average driver wasting 67 hours on the road and 32 gallons of fuel annually, and 97,000 crashes each year ue to sudden speed drops and mandatory lane changes. To improve mobility and safety, a new federal rule requires all state transportation agencies to implement mobility assessments of rehabilitation project's effects on daily commuters and business interests. These assessments are critical, but they are also difficult to perform and expensive to conduct, with the primary problem being a lack of effective analytical tools and methods. No comprehensive but effective methods or tools are currently available to mirror the unique dynamics of highway rehabilitation work such as traffic state change, capacity change, travelers' behavior change, and various closure alternatives for a long-term repetitive work. WISE determines an optimized renewal programming schedule that lessens delays and reduces agency cost by evaluating the impact of individual alternatives. Users can evaluate the effectiveness of various travel demand and construction duration strategies through comparisons of two main criteria such as construction cost and traveler delay cost. Its main outputs are: 1) optimal project schedule and 2) optimal project sequencing. Recently, its Operation Module can compute a diversion of traffic based on more specific work zone information. Current methods are often time-consuming, costly, and error-prone. Thus, despite considerable advances in the use of sensor-based big data in transportation planning and management, big-data-based mobility prediction specifically for urban highway rehabilitation projects clearly lacks necessary precision, speed, and reliability. Accordingly, there is an urgent need to develop a means of correcting and improving the results of work zone mobility modeling.

## Objectives

The objective of this study is to create a unified data-driven model for autonomously predicting the levels of mobility disruption (i.e., delayed minutes) caused by the presence of a critical work zone under arbitrary and user-defined "what-if" rehabilitation scenarios. The proposed research project will result in a significant leap forward in the ability of DOT planners and engineers to quickly and efficiently (a) assess the impacts of pursued highway rehabilitation alternatives and (b) select the most feasible construction phasing/staging scenarios, and thus (c) significantly improving mobility and reducing the number of safety incidents in and around work zones. This research will greatly benefit agency engineers, local daily commuters and businesses in Region 6 in general by significantly improving

mobility and safety while also positively affecting regional development.

## Intended Implementation of Research

**Workforce Development:** The potential impact of the proposed SWAT model goes far beyond transportation infrastructure planning and management and offers numerous social benefits by enabling transformative applications in critical infrastructure rehabilitation planning, engineering, advanced intelligent transportation systems, urban planning, land use, public outreach, economics and travelers' proactive trip planning. Furthermore, this research will positively affect the environment by reducing transport fuel and emissions. In terms of financial cost, the proposed SWAT model will potentially save taxpayers millions of dollars by providing a more reliable, smarter, and greener method than any in existence today, because mandated CWZ assessments for a significant project can easily cost several million dollars.

**Outreach:** The PIs will actively present the research outcomes at regional meetings of Parishes in Louisiana as well as quarterly meetings of the Construction Industry Advisory Council, industry support groups of the LSU Construction Management department and TAMU Construction Science Department. In addition to presentations at reputable conferences, the research team will disseminate the research results through publications in prominent professional journals and diverse media.

**Education:** The research results will be used to create educational material in Civil Infrastructure Informatics (CII), a graduate course PI Choi and Lee will co-develop at TAMU and LSU. For the new course, the PIs propose an innovative three-part high-impact educational plan: (1) develop a concept inventory for an interdisciplinary graduate course in CII, (2) shift the CII course to a fully problem-based environment that utilizes the concept inventory, and (3) widely engage communities in the problem-based research projects via the State Target Cities Program. We, therefore, will present this project to K-12 teachers at an annual teacher summit, and they will disseminate their learned knowledge to K-12 students.

## Anticipated Impacts/Benefits of Implementation

This research will greatly benefit researchers and industry practitioners, the general traveling public, and society in general by significantly improving mobility and safety in and between CWZs, and positively affecting regional development. The potential impact of the proposed SWAT model goes far beyond transportation infrastructure planning and management and offers numerous social benefits by enabling transformative applications in critical infrastructure rehabilitation planning, engineering, advanced intelligent transportation systems, urban planning, land use, public outreach, economics and travelers' proactive trip planning. Furthermore, this research will positively affect the environment by reducing transport fuel and emissions. In terms of financial cost, the proposed SWAT model will potentially save taxpayers millions of dollars by providing a more reliable, smarter, and greener method than any in existence today, because mandated CWZ assessments for a significant project can easily cost several million dollars.

## Web links

- TranSET's website (https://transet.lsu.edu/research-in-progress/)
- TRB's Research in Progress (RIP) database (https://rip.trb.org/View/1642169)

## Tran-SET

Tran-SET is Region 6's University Transportation Center. It is a collaborative partnership between 11 institutions (see below) across 5 states (AR, LA, NM, OK, and TX). Tran-SET is led by Louisiana State University. It was established in late November 2016 "to address the accelerated deterioration of transportation infrastructure through the development, evaluation, and implementation of cutting-edge technologies, novel materials, and innovative construction management processes".

## Learn More

For more information about Tran-SET, please visit our website, LinkedIn, Twitter, Facebook, and YouTube pages. Also, please feel free to contact Mr. Christopher Melson (Tran-SET Program Manager) directly at transet@lsu.edu.