PROJECT R11

Strategic Approaches at the Corridor and Network Levels to Minimize Disruption from the Renewal Process

JULY 2014

Program managers within state departments of transportation (DOTs) and metropolitan planning organizations (MPOs) are charged with organizing a chaotic universe of identified renewal needs into a logically sequenced program of manageable projects. In addition, the sequencing is expected to maximize available resources and minimize disruptions to the traveling public and to adjacent land uses. Over the past several years, substantial progress has been made in the areas of performance measurement, maintenance of traffic, mitigation of congestion in work zones, and alternative contracting and construction techniques. This progress has been made in studies and planning designed to minimize, manage, and mitigate disruption to traffic and commerce arising from renewal programs. In application, however, impacts of highway renewal activities are analyzed largely at the project level and not at the program (mesoscopic) level, where time and cost savings can be optimized.

To realize these savings, new dynamic tools, techniques, and processes are needed to execute highway renewal activities at the corridor and network levels and to measure risks from the perspective of constructability, funding, economic/environmental/social constraints, as well as congestion and safety impacts. This project in the Renewal area of TRB's second Strategic Highway Research Program, Strategic Approaches at the Corridor and Network Levels to Minimize Disruption from the Renewal Process (R11) addressed those needs. The products developed from the research include WISE, a software tool to assist program managers in sequencing programs of projects, and the WISE User Guide.

Work Zone Impact and Strategy Estimator Software

WISE is a decision support system for use by planners and engineers to help them evaluate the impacts of work zones and determine strategies to reduce these impacts. WISE has the capability to evaluate the regional impact of various strategies such as day/night operations, innovative contracting, fast construction techniques, advanced maintenance of traffic plans and public information programs. Figure 1 illustrates the basic purpose of the software.

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Figure 1. Basic purpose of the WISE software (the acronyms refer to management systems for pavements, bridges, congestion, safety, and construction projects)
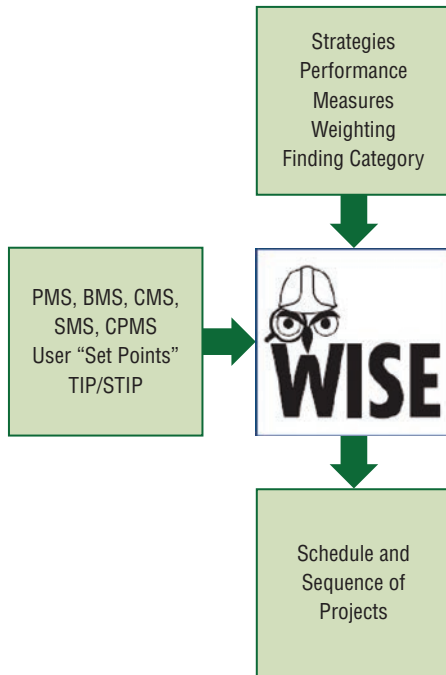
The flow of the program delivery process, and how planners and engineers would need to use this tool was central to its development. Because continual analysis would be needed in this process, the WISE tool allows multi-resolution modeling in which data can be passed from macro- to mesoscopic level models, shown in Figure 2, to work in a consistent manner with reasonable ease.

WISE was developed based on the definitions and guidelines proposed in the Work Zone Rule Section 630.1010 of 23 CFR Part 630 and supports agency adherence to the rule. The software development was shaped by the following foundational principles, which were confirmed through workshops and interviews:

- WISE must work with existing management systems (for pavements, bridges, safety, congestion, and construction programs and others);
- WISE must not require the agency to add personnel in order to operate it;
- WISE must be affordably procured and supported;
- WISE must rely on existing or easily obtained data sources; and
- WISE must be simple and intuitive to use and robust enough to deal with a lack of detailed inputs.

The software has the ability to evaluate the impact of multiple projects that have been incorporated into a transportation improvement program and the network. Therefore, the level of effort in conducting analysis is minimal.

WISE can be used to address the following questions:

- What is a good scheduling of renewal projects?
- What strategies are cost-effective with mitigated user delays (congestion) for a program?
- Which traffic management plans work best in given conditions?
- What is the impact on traffic of the present program?

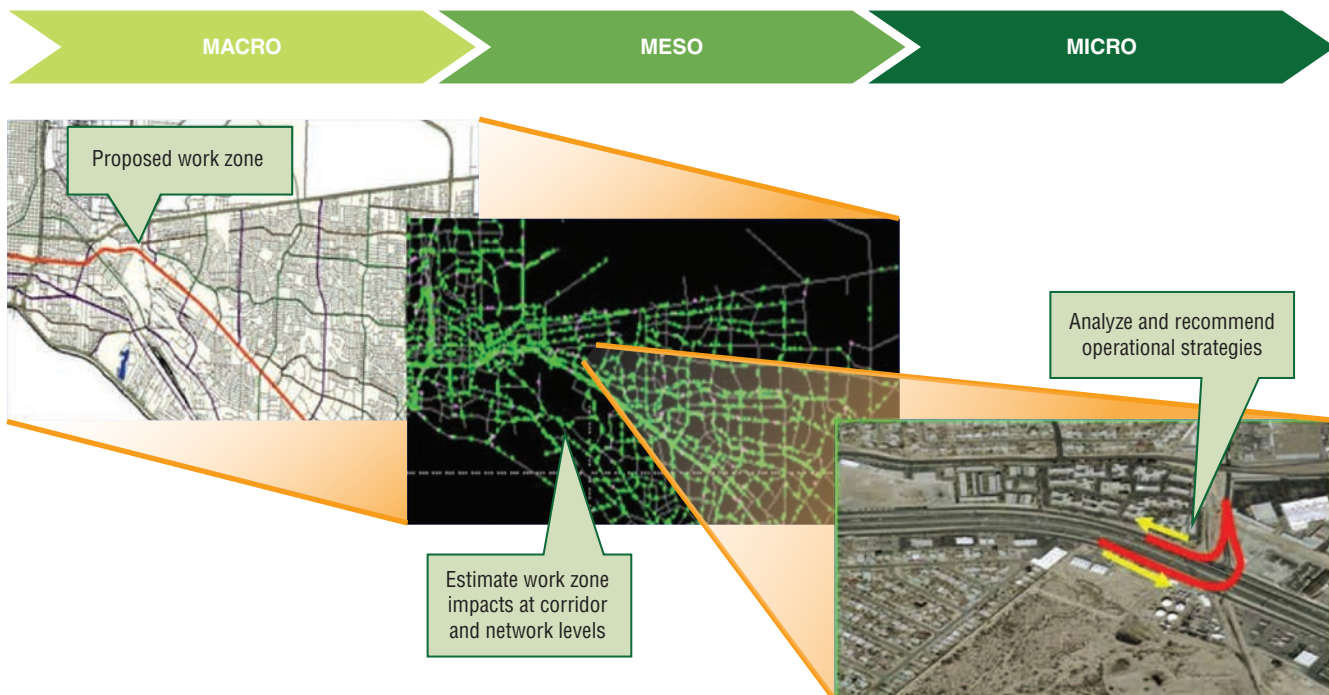## Modules for Planning and Operations

WISE evaluates renewal projects at both the planning and the operations levels. When used as a planning tool WISE develops an optimized renewal programming schedule that minimizes delays to the public and agency cost. When used at the operational level it evaluates the impact of individual strategies at the project level; the results can then be used as part of an iterative procedure with the planning analysis. The WISE tool does not require the use of proprietary software and builds on the existing network traffic simulation software used by transportation agencies and MPOs.

In the Planning Module users can evaluate the effectiveness of various travel demand and construction duration strategies for multiple projects through comparisons of two main criteria: construction cost and traveler delay cost (that is converted to monetary cost). Its primary output is a proposed sequencing of projects to minimize overall costs. Other costs, such as travel time reliability and environmental impacts are not considered in this initial version of the WISE tool.

The Operations Module uses DynusT to provide its main functionality. The concept behind the Operations Module is to dive deeper into the granularity of the time-varying interactions occurring between traffic and the network during a work zone project. What a static model cannot capture—time-dependent congestion and diversion caused by congestion—a simulation model such as DynusT can. DynusT can still use the macroscopic network yet provide in-depth information of a microscopic simulation model.

In the Planning Module, static assignment (user supplied or WISE supplied) is coupled with information regarding the planning characteristics of the program, a user-defined library of demand-based and duration-based renewal strategies, and basic project information. Optimal project sequencing is developed based on user and agency costs. Traffic diversion resulting from projects can be computed by WISE, or entered manually for each project by the user.

Figure 2. Multi-resolution modeling

Later, in the Operations Module, the DynusT Dynamic Traffic Assignment platform will also compute a diversion of traffic based on more specific work zone information. The Planning and Operations modules 'handshake' with each other seamlessly and the user is not required to re-enter traffic or network data.

The graphical user interface (GUI) includes a number of validation checks, as well as user support features. The GUI is the link between the key WISE tools and metadata within the software package. In addition to the Planning and Operations modules, these key tools include analysis engines, DynusT, and NEXTA. The GUI links these tools using a WorkSpace concept. A single WorkSpace gathers the metadata necessary to define a network, multiple projects, variables, and scheduling data needed to successfully evaluate a given scenario in the Planning and Operations modules.

Limitations of the software

The current version of the software operates within the following limitations:

- The model's data structure links very well with DynusT, but needs to be expanded to include other software;
- At the planning stage the model does not consider improvements in capacity and free-flow speeds;

- Significant effort is needed to calibrate the mesoscopic model;
- Risks associated with construction are not considered; and
- Explicit consideration of materials and workflow of the construction process are not modeled.

The WISE User Guide

The User Guide clearly describes and illustrates step-by-step instructions for installing and using the software. It includes a glossary and an annotated bibliography. The Guide and the WISE software were pilot tested in Iowa, Arizona, New York, and Florida.

Products

Strategic Approaches at the Corridor and Network Level to Minimize Disruption from the Renewal Process, the WISE User Guide, and the decision support software are available from TRB's website at: http://www.trb.org/Main/Blurbs/168143.aspx.

The project is currently managed by **David Plazak**, *TRB Senior Program Officer.*

Project Briefs are also available for the following Project Delivery topics:

Meeting the Challenges of Rapid Renewal Projects (R03, R07, R09, R10, R11)

Guide for Managing Risk on Rapid Renewal Projects (R09)

Strategies for Managing Complex Projects (R10)