INDOT Research

# TECHNICAL *Summary*

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# *A Highway Travel Information System: Forecasting and Publicizing Delays in the Indiana State Highway Network*

## Introduction

The Highway Travel Information System (HTIS) is a long-term pre-trip information system providing information about expected events, such as road constructions. Recent research has focused on real-time and short-term pre-trip information system. Real-time and short-term pre-trip information systems are the most beneficial to those drivers already on the road or about to depart. The HTIS can be beneficial to both highway travelers and construction managers of roadway projects. Construction managers can use the HTIS to check the forecasted traffic impacts of a proposed construction project schedule. Travelers who have flexible schedules and would like to do pre-trip planning to avoid unnecessary delays can obtain knowledge of traffic conditions in the near future from the HTIS.

An approach called Workzone Delay Equilibrium Estimation (WDEE) is used by the HTIS to predict traffic conditions as construction zones age. Two extreme values of link volumes are calculated based on two scenarios: "no information", in which no drivers know about a new road capacity reduction, and "complete information", in which all drivers have adequate information about road construction zones. A relationship between link volumes and the age of a project has been hypothesized and applied to the two extreme cases to estimate link volumes during construction periods. Finally, expected delays on links under construction are estimated based on the estimated link volumes.

The objectives of the HTIS are:

- To predict the delays on the major highways in Indiana that are caused by scheduled roadway projects for expected travel levels and patterns;
- To build a user-friendly interface providing individuals and institutions with easy access to this travel information system;
- To provide INDOT with a method to review (and possibly revise) its construction project schedules;

To establish standard procedures to operate, maintain and update the HTIS.

## Findings

The delays in relation to the age of construction are estimated using the approach of Workzone Delay Equilibrium Estimation (WDEE) hypothesized for the HTIS. WDEE involves the following three steps:

1. Analysis for the "no information" scenario:

In the "no information" scenario, the traffic demands on each link with no construction and at the beginning of road construction are treated the same. The "no information" link flows are estimated based on historical flows at the time before the workzone is added, using a simplified traffic volume forecasting technique developed for the HTIS. The travel delays for the "no information" case can be estimated by applying queueing theory using the "no information" link flows as arrival rates and workzone capacities as service rates.

2. Analysis for the "complete information" scenario:

In the "complete information" scenario, it is assumed that drivers will divert to alternate routes rather than change their departure times to minimize delays. The travel between each O-D pair for a specific time period and day type is treated to be the same for both the "complete information" and "no information" scenarios. To simulate the "complete information" scenario, two analyses are involved – O-D estimation and traffic assignment. O-D estimation generates an O-D table based on the link flows for the "no information" case. Equilibrium traffic assignment is applied to the network with workzone capacities in place, using the O-D table obtained from O-D estimation. The travel delays for the "complete information" case can be estimated by applying queueing theory using the "complete information" link volumes as arrival rates and workzone capacities as service rates.

3. Estimation of delays during the construction period

The delay on a link is related to the traffic flow on the link. In queueing theory, it is assumed that delay occurs on a link when the traffic volume is greater than its capacity. When delay occurs, the delay on a link decreases as the link volume decreases. The volumes at a workzone are expected to decrease as construction proceeds and more drivers become aware of the construction. The traffic patterns during the construction period are determined by analyzing historical traffic data during construction periods. The relationship between the historical data and the age of construction can be applied to the links in workzones to obtain expected link volumes at any time during the construction period. The expected delays on each link can be estimated based on the expected link volumes.

## Implementation

The HTIS is divided into three subsystems for the purpose of meeting the needs of different groups of users. They are the modeling, project scheduling, and web access subsystems. The modeling and project scheduling subsystems are for management purposes and the web access subsystem is for use by the traveling public.

1. Modeling subsystem

The modeling subsystem is built using the Excel VBA and the TransCAD GISDK interfaces. The Excel VBA interface implements the simplified traffic volume forecasting technique proposed by HTIS. The TransCAD GISDK interface performs the analysis of the "no information" scenario, the "complete information" scenario, Workzone Delay Equilibrium Estimation (WDEE) during the transition construction period, delay estimation and delay database generation.

2. Project scheduling subsystem

The project scheduling subsystem is built using the TransCAD GISDK interface. There are two major tasks for the project scheduling subsystem. The first one is to manage construction schedule databases. The second one is to assist project scheduling personnel in determining scheduling strategies that avoid excessive delays to traffic by providing functions to adjust project starting date, end date, and lane closure strategies in terms of workzone capacities.

3. Web access subsystem

The web access subsystem is built on several scripting languages, including Hyper Text Markup Language (HTML), JavaScript, VB-script, and Active Server Pagers (ASP). The JavaScript and VB-script provide an interactive environment. Drivers may input their desired departure time and receive information about expected delays at workzones that are active during their proposed trips. Motorists can use the information to plan their trips up to two months in advance.

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