INDOT Research

TECHNICAL *Summary*

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Evaluation of the Impacts of ITS Technologies on the Borman Expressway Network

Introduction

The lndiana Department of Transportation (INDOT) is currently implementing (Or has implemented) several components of Intelligent Transportation Systems (ITS). This includes a mini Advanced Traffic Management Systems (ATMS) implemented on a three-mile stretch of the Borman Expressway to evaluate advanced non-intrusive sensor systems and the associated communication infrastructure for the installation of a full-scale ATMS on the 16-mile stretch of the Borman Expressway, Potential specific ITS technologies that are either being implemented or are being considered include the following:

(i) Pre-trip Information: This information provision mechanism prior to the start of the trip provides users who access an automated service in the TOC the current best path to their destination. Other mechanisms include news media or BAR, which provide information on current traffic conditions in the network and/or route advisories.

(ii) En-Route Information: This capability exists for users who equip their vehicles with an in-vehicle mitigation system or access the automated service en-route through a cellular phone. Such a capability allows users to make informed mute switching decisions en-route when network conditions change during the trip.

(iii) Variable Message Signs: VMS can be permanently installed at key locations or they can also be temporarily located (portable VMS) in the vicinity of incidents

(iv) to manage traffic efficiently for the duration of the incidents. Placed at strategic locations, these signs can warn motorists of congestion that lies ahead due to an incident, special event, adverse weather, or other bottlenecks (work zones), and inform them of alternate diversion of detour routes.

(v) Hoosier Helpers: The implementation of Incident Management Systems (IMS) on Borman Expressway is aehieved by the Hoosier Helper program, using special highway patrol trucks equipped with advanced communications equipment, a video camera, a video monitor, and emergency equipment for stalled vehicles. They have been identified as the system operator in the field and an essential player in the rapid detection, verification, response, and removal of incidents

It is expected that the implementation of various ITS technologies on the Borman Expressway will result in improved traffic flow, lower travel times, higher average speeds, and improved safety and environment. This study aims at evaluating the impacts of these ITS technologies on mobility, air quality, and safety on the Borman Expressway and its vicinity. While only some of the above described technologies are planned for the near future, the impacts of the other technologies such as en-route navigation systems and automated service at the TOC are also evaluated to aid future ITS planning efforts in the Borman region.

Findings

Evaluation of ITS Impacts on Mobility: The impacts of ITS on mobility were evaluated by simulating the performance of various ITS components under normal and incident conditions for the Borman Expressway Evaluation Network, and comparing the results with the corresponding scenarios in the absence of these technologies. The ITS components simulated were IMS, VMS, F're-Trip Information, and En-route Information. It was observed that en-route information provides maximum travel time savings when compared with the other technologies. Furthermore, the results suggest that the network can accommodate the vehicles that divert from Borman Expressway, indicated by the decrease in the overall network average travel time with increase in market penetration of information. Hence, providing en-route route diversion information to some users can result in significant benefits in terms of travel time savings and congestion alleviation.

Evaluation of ITS Impacts on Air Quality: The impacts of ITS on air quality were evaluated by simulating the performance of various ITS components under normal and incident conditions for the Borman Expressway Evaluation Network, and comparing the resulting HC, CO, and NO, emissions with the emissions under a do-nothing scenario. The same network was used for air quality impact evaluation that was used for evaluating the mobility impacts of ITS. The ITS components simulated were IMS, VMS, and En-route Information. The results obtained from the simulation experiments indicated that significant improvement in air quality can be achieved by effective implementation of various ITS technologies under normal and incident conditions. It was observed that for normal peak-hour conditions, maximum reduction in HC and CO emissions can be achieved by providing en-route information to the users, while maximum reduction in NO, emissions can be achieved by using the VMS. Incase of incident conditions, the maximum reduction in HC and CO emissions was seen from IMS implementation while VMS still proved to be the most effective for NO, emissions reduction under these conditions. One important trend observed from the results of these experiments was that the magnitude of reduction in mobile emissions was highest under incident conditions with link closure, aud lowest under normal peak-hour conditions.

Evaluation of ITS Impacts on Safety: The safety impacts of ITS were evaluated by testing the hypothesis that secondary crashes may take place as a direct result of primary incidents or traffic congestion. Logistic regression modeling was used to predict the likelihood (risk) of a primary incident being followed by a secondary crash, using the "best" combination of primary incident characteristics. The resulting models suggested that the likelihood of a secondary crash occurring increases with an increase in the primary incident clearance time, and with the involvement of a car, semi, or truck. The likelihood decreases during the winter months and on ramps or median shoulders. Given a better understanding of what contributes to secondary crash occurrence, various components of ITS technologies can be upgraded or adopted, and more effective relief strategies be implemented to reduce secondary crash occurrence and improve roadway safety.

Implementation

The research results will be used in implementing the second phase of the Borman Expressway ATMS. The implementation is expected to be undertaken by the ITS office of the INDOT. Further work my be necessary to investigate in detail the air quality and safety impacts.

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