

### DEVELOPMENT OF A CONGESTION MANAGEMENT SYSTEM USING GPS TECHNOLOGY

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#### INTRODUCTION

An important component in the development of Congestion Management Systems (CMSs) is the capability to measure congestion accurately and reliably. One of the best measures of congestion is travel time. However, current travel time data collection techniques tend to be expensive, labor intensive, and prone to frequent errors both in the field and in the office. As a result, only a few runs are usually made and, of these, many are affected by severe inaccuracy problems. It is essential to eliminate these problems so that Metropolitan Planning Organizations (MPOs) can conduct the necessary travel time studies required for implementing CMSs.

#### OBJECTIVES

The overall goal of this research study was to demonstrate the feasibility of using global positioning system (GPS) and geographic information system (GIS) technologies to measure travel time and speed data on urban highways. Compared to more traditional approaches for conducting travel time studies, which require a significant amount of manual field work and are prone to recording errors, the methodology described here dramatically increased productivity and virtually eliminated data collection and data reduction errors.

#### PROCEDURES

The GPS/GIS methodology includes data collection, data reduction, and data reporting procedures. The data collection procedure is based on the use of GPS receivers to automatically collect time, local coordinates, and speed every one second. This provides an accurate depiction of vehicle location and speed. GPS was also used for constructing base vector maps needed for overlaying GPS-derived travel time data. Checkpoints in the vector maps included both physical discontinuities such as signalized intersections,

on-ramps, and off-ramps, as well as a number of intermediate checkpoints between contiguous physical discontinuities. Because GPS receivers collect a huge amount of data, a filtering and reduction procedure was devised to decrease the amount of data to be stored, without seriously impacting the quality of the original data. This procedure was based on the aggregation of GPS data using highway segments which are nominally 0.2 miles in length. However, the model is sufficiently general so that other segment sizes can be easily accommodated. The data reduction and storage system is based on a geographic database that uses a relational database model. The GIS-based model allows for both spatial and non-spatial queries, therefore providing the possibility of a wide variety of data reporting options in addition to the traditional speed-distance or speed-time profiles. For this study, the following data reporting options were used: hard copy color coded maps and archival tabular reports; and on-line Internet-based reports. Color coded maps show the spatial variation of items such as speed and travel time and are particularly suitable for explaining travel time delays and congestion issues at public meetings. Tabular reports offer a very compact way of archiving travel time and speed data along highway segments. This makes them suitable for archival and analytical purposes. The procedure to produce these tabular reports has been automated, thereby increasing the usefulness of such an approach. Reporting procedures using WWW resources were also implemented (<http://www.rsip.lsu.edu/cms/cmsbtr/cms-query.html>). These procedures allow any user with access to the Internet to select highway segments and retrieve all records associated with these segments.

#### APPLICATIONS

The methodology described above was used to obtain travel time and speed data needed for developing

