



# *The Ohio Department of Transportation Office of Research & Development Executive Summary Report*

## **The Columbus Metropolitan Freeway Management System (CMFMS) Effectiveness Study: Part 2 - The After Study**

*Start Date: February 1, 2004*

*Duration: 25 months*

*Completion Date: March 31, 2006*

*Report Date: August 2006*

*State Job Number: 134152*

*Report Number: FHWA/OH-2006/19*

*Funding: \$118,814*

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### **Problem**

The Ohio Department of Transportation (ODOT) deployed the first phase of the Columbus Metropolitan Freeway Management System (CMFMS) along 14 miles (22.5 km) of I-70 and I-71. The system includes loop detector stations every 1/3 mile (0.5 km), ramp meters, 4 changeable message signs (CMS), and an integrated traffic management center (TMC) to coordinate different government agencies and the media. The system became operational at the end of 2001. This study evaluates the performance of the first phase to both understand the operation of the facility and to help guide future investments in the CMFMS and other FMSs across the state of Ohio. The second phase build-out is currently under construction and is scheduled to be completed in 2006.

Although the primary objective of this study is to evaluate the performance of the CMFMS, the effort developed calibration tools and performance measures that should also prove useful for ongoing operations. Data for this evaluation were collected on the mainline and ramps using the CMFMS loop detectors, dedicated probe vehicle runs and Central Ohio Transit Agency (COTA) automatic vehicle location (AVL) system on transit vehicles in the corridor. This study provides quantitative and qualitative results such as: travel times, speed data, traffic volume, and traveler delay. The study develops a suite of performance monitoring tools both to assess the performance of instrumented freeways and the reliability of the surveillance system. It also provides a comprehensive overview of the given traffic monitoring system for practitioners, allowing them to optimize the system. In the course of this work we integrated information from many sources to meet multiple objectives for system management and monitoring.

## Objectives

The primary objective of this study was to evaluate the performance of phase I of the CMFMS. This task was accomplished both at the sensor level (are the measurements correct) and at the operational level (are the control actions correct).

## Description

This study collected detector data from the CMFMS normally used for real-time decision-making and then used these archives to assess and diagnose the health of the system. Supplementary tools were developed that employed floating cars (which proved particularly efficient for assessing the performance of ramp meters) and other available data sources (e.g., transit AVL).

The tools and methods developed are general and can be applied both to later phases of the CMFMS and to other FMSs. The lessons capture both a snapshot of system performance and provide immediate action items to improve system performance.

As originally conceived, this study was meant to be a companion to a before study data collection to quantify the impact of the CMFMS. This goal is still retained, but it is limited by two facts, first much of the before data were collected over only two weeks while the after data were collected over three years. Second, and more importantly changing traffic patterns due to the closure and opening major links in the larger highway network impacted measurements or traffic demand during the period of data studied in this research.

## Conclusions & Recommendations

This research examined the performance of the detectors to verify they are operating correctly. Careful evaluation of the data revealed many significant detector errors, many of which we were able to correct for. Work then shifted to the operation of the CMFMS as a whole. We developed many different ways to graphically mine historical data from the system. One of the fundamental tools is our so-called summary plot, showing the evolution of speed over time and space. This plot shows queues growing and shrinking in response both to recurring and non-recurring congestion. It also shows many system failures that prevent data measurement at one or more stations. Once comfortable with these plots, one can easily review conditions from an entire month on a single sheet of paper. We also examined several measures to capture conditions experienced by travelers, including delay and ADT. This work also evaluated the operation of the ramp meters. Several problems were identified, the largest being the presence of mainline congestion while the adjacent meter remains off. Finally, comparisons were made between travel speeds and volumes before and after the CMFMS was turned on.

## Implementation Potential

This research was conducted in close coordination with the TMC staff and many lessons have already been implemented (e.g., problems with the ramp meters turning on in the middle of the night and detector-mapping errors). Other problems remain and should receive attention soon (e.g., ramp meters remaining off while the mainline is congested). The health of the system is continually evolving, so this analysis should become part of day-to-day operations at ODOT to keep any future failures in check. One important tool in such an effort archiving the data at the highest resolution possible (30 sec, or sub-second if available), the storage cost has become negligible. Although most current off-line applications do not utilize such high resolution data, without such archival activities, future applications will similarly be limited to lower resolution data. Finally, we believe that it would be of benefit for ODOT to develop these skills either in house or collaboratively with other agencies.