Comparison of Turning Movement Count Data Collection Methods for a Signal Optimization Study

White Paper

URS

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for a Signal Optimization Study

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Background

Turning movement counts, which represent the various approach movements (left, thru, right) that pass through an intersection over a given period of time, are collected for a variety of purposes at signalized and unsignalized intersections. In 2010, turning movement counts were collected by URS Corporation using the Video Collection Unit (VCU) developed by Miovision Technologies.   The data was used to aid in a comprehensive traffic signal optimization study for the Western Ottawa Traffic Signal Optimization project in Ottawa County, Michigan. Ottawa County is located in west Michigan with a population of approximately 262,000, including the Holland urbanized area with a population of 96,000 and the Grand Haven urbanized area with a population of 31,000. The project was sponsored by the Macatawa Area Coordinating Council, and the participating jurisdictional agencies were the Michigan Department of Transportation, the Ottawa County Road Commission, the City of Holland, and the City of Grand Haven.

URS Corporation has completed numerous signal optimization studies, corridor studies, and other traffic operational and safety studies that require turning movement count data. Common goals for traffic signal optimization studies include:

- o Reduce fuel consumption and emissions
- o Improve (reduce) vehicle travel times
- o Standardize traffic signal operation parameters, including pedestrian crossing clearance time updates
- o Improve transportation safety for motoring public, pedestrians, and bicyclists
- o Improve mobility without additional capital investment in road and bridge improvements

Project Summary

The Western Ottawa Traffic Signal Optimization Study included extensive data collection for 129 intersections, including eight (8) hours of turning movement counts at each intersection (7:00 to 9:00 AM, 11:00 AM to 1:00 PM, and 2:00 to 6:00 PM). The turning movement counts included three count classifications: passenger vehicles, heavy vehicles, and pedestrians. The contract required that turning movement data be collected only on Tuesdays, Wednesdays, and Thursdays. Based on the project schedule, 122 of the 129 intersections had to be counted over an 8-week span in April and May of 2010, before the area schools were dismissed for the summer.

To meet the aggressive project data collection schedule and limited project budget, URS selected two methods for collecting the intersection turning movement data: manual turning movement counts performed by technicians in the field and automated turning movement counts using VCUs developed by Miovision Technologies. The VCU data collection method reduced the number of field technicians performing manual counts, reduced labor costs, and allowed a greater amount of data to be collected within the constraints of the project schedule. The Western Ottawa Traffic Signal Optimization project was the first time that URS utilized VCUs for turning movement data collection, so plans were made to validate the veracity of the VCU-generated data.

The VCU is a digital camera that records all traffic and pedestrian movements. The video recording is processed to obtain traffic and pedestrian volume counts. After successfully testing a VCU for accuracy, URS rented eleven (11) VCU's for the signal optimization study. All told, a total of 86 intersections were counted by VCU (80 intersections in the spring, 6 intersections in the summer) and 43 intersections were counted manually by trained field technicians (42 intersections in the spring, 1 intersection in the summer).

For roadway cross sections up to five lanes wide, one VCU was sufficient to view and capture intersection traffic. For roadway cross sections up to six lanes wide could be counted with one VCU if there was no intersection skew and a mounting pole was located close to the corner. Two VCU's were required at some intersections, such as skewed intersections, boulevards and wide streets. Of the 129 intersections, 33 intersections required two VCU's. Based on the project schedule and technician availability, 12 of the 33 intersections were counted with two VCU's and 21 of the 33 intersections were counted manually by field technicians.

Project Outcome

The field-collected data was used to develop optimized traffic signal timings, which resulted in many benefits to travelers in western Ottawa County. The project benefits included:

- Overall cost-benefit ratio was 12.5:1, with an annual savings to the motoring public of $5 million.
- Fuel consumption reduction (saving over 273,000 gallons annually).
- Air pollution reduction (over 1,000 tons annually).
- Travel time improvements (saving over 311,000 vehicle-hours of delay annually).
- 13 of 15 corridors experienced travel time reductions.
- Traffic signal hardware improvements (including GPS clocks to aid in maintaining coordination).
- Anticipated vehicle crash reduction of 10% based on historical results from a similar signal study.

Data Collection Methodology

Following is a description of the two methods of turning movement count data collection utilized in the Western Ottawa Traffic Signal Optimization Study.

Manual Data Collection
Manual turning movement data collection is a labor intensive effort. Many engineering firms do not have in-house staff available to perform turning movement data collection for large projects. Some firms hire and train temporary workers to perform data collection. For the Western Ottawa Traffic Signal Optimization Study, URS utilized one full-time employee and four field technicians to perform data collection.

For each manual count, a field scoping visit was needed to determine feasible locations for the field technicians performing the counts, to receive approval of businesses to park in lots with good views of the intersection, and to determine manual count assignments.

Miovision VCU Data Collection
URS mounted each VCU to an existing pole or post for stability purposes. Once trained, a technician could install a VCU in approximately 15 to 20 minutes and pick up a VCU in approximately 5 to 10 minutes. A high-resolution aerial image of the intersection was helpful to record the exact location of the VCU installation. Installations were typically located adjacent to utility poles (see photo), but could also be mounted on signs with wood posts. When installing on utility poles, the local utility company was contacted to obtain permission to use the pole. A weather-protected, laminated card was strapped to each VCU with names and phone numbers of contact persons at URS, including a brief description of why the unit was installed there (see photo). No theft or vandalism of the VCU equipment occurred over the course of the project. Using a VCU to count an intersection was not as time consuming as using trained technicians to manually count traffic.

VCU Pole Installation   **VCU Pole Installation with Laminated Card**

VCU data collection provided many benefits compared to manual data collection. Due to the sheer magnitude of data collection and short time frame for the signal optimization study, it would have been difficult to complete manual turning movement data collection within the 8-week time period. In order to count 122 total intersections, <u>eight</u> trained field technicians would have been needed per day for three shifts totaling eight hours per day. Turning movement counts were targeted for Tuesdays, Wednesdays, and Thursdays only.

Accuracy Results

Both manual and video turning movement data was collected at the two intersections on a weekday in a small city downtown setting. Two technicians manually collected counts at each intersection (e.g., one technician would count all northbound and westbound movements and one technician would count all southbound and eastbound movements). One intersection was counted during the morning peak period (7:00 to 9:00 AM) and the other intersection was counted during the midday peak time period (11:00 AM to 1:00 PM).

Validation of the count (actual count) was then compared to the manual (technicians in field) and Miovision (VCU) turning movement counts to measure the accuracy of the manual and VCU counts. **Table 1** describes each turning movement count method.

Validation involved two separate field technicians watching the same VCU video independently and counting the vehicles on the video using a hand-held electronic counting device. The two field technician counts of the VCU video were very similar, ranging from 0.1% to 0.3% differential for each of the four hours, so an average of these two counts were used as the video validation benchmark. **Table 2** provides a summary of the verification results for the manual and VCU count methods.

Table 1
Turning Movement Count Methods

TMC Method	Method Description
Video Validation (actual count)	Two separate technicians watching the same VCU video independently and counting the vehicles at an intersection on the video using a hand-held electronic device.
Manual (in field)	Two technicians counting the vehicles at an intersection using a hand-held electronic device.
Miovision (VCU)	One pole-mounted VCU recording the vehicles at an intersection with a digital camera.

TMC Method	7:00 – 8:00 AM	8:00 – 9:00 AM	11:00 AM – 12:00 N	12:00 – 1:00 PM	Range of Variance
Video Validation (actual count)	1319 vehicles	1257 vehicles	1767 vehicles	1791 vehicles	-
Manual (in field)	-0.8%	-2.2%	-0.8%	-0.9%	-2.2% to -0.8%
Miovision (VCU)	-0.4%	-0.2%	+0.6%	0.0%	-0.4% to +0.6%

Source: Turning Movement Counts conducted by URS Corporation, spring 2010.

As seen in Table 2, the VCU produced count results that were marginally more accurate than manual counts. Manual count accuracy for hourly time periods ranged from -0.08% to -2.2%. VCU count accuracy ranged from -0.4% to +0.6%. Based on the range of variance depicted in Table 2, VCU counts were more than 99% accurate and manual counts ranged between 97% and 99% accurate.

Benefits of the Miovision VCU Data Collection Method

With nearly 700 hours of experience using the Miovision VCU technology for the Western Ottawa Signal Optimization Study, URS Corporation was satisfied with the performance of the VCU data collection method. The ability to program the units to count on multiple days and time periods at remote locations resulted in substantial time and cost savings.

A key feature of the Miovision VCU was convenience. Power Packs (providing extra battery power) were valuable for instances where multiple counts were conducted over the course of several days or when extended counts were needed, such as a 12-hour turning movement count at one location for a signal warrant study. VCU poles were best transported in a medium-to-large SUV or mini-van as the collapsed pole with base is approximately 6'-6" long. URS was able to fit all 11 VCU's and related components into one large SUV, with some room to spare.

Because VCU units can be deployed by a single field technician at many intersections in a short period of time, labor costs were reduced. In the office, a particularly useful feature is that the video recording could be referenced at any time on the Miovision website to check traffic counts, pedestrian counts, queuing, delay, commercial vehicle counts, or any other intersection characteristics.

Summary and Findings

Miovision VCU-based traffic counts were found to be over 99% accurate. These accuracy rates were marginally greater than the accuracy rate of manually-collected data. URS used the VCU data collection method at intersections of all sizes, including large, skewed, and busy intersections. Miovision customer support and video recording upload process were convenient and straightforward.

Upon completion of the Western Ottawa Traffic Signal Optimization Study the primary project sponsor, the Macatawa Area Coordinating Council, wrote a letter of recommendation regarding URS performance, noting that "URS was required to complete data collection in a very short time frame which they were able to do using a very innovative strategy", referring to the VCU-based data collection.

The primary benefits of the VCU data collection method was 1) the ability for a single field technician to conduct data collection at several intersections, 2) quick installation and removal, and 3) the ability to review VCU video recordings at any time to verify the traffic and pedestrian characteristics. These benefits reduced

project costs (particularly labor and expenses) and time spent in the field, improving the ability of the engineer to verify that the traffic and pedestrian data is accurate.