Quarterly Project Report

Center for Transportation Studies

Project Title: **Toward A Multi-State Consensus on Rural Intersection Decision Support**

Quarter: **July 01 - September 30, 2007**

CTS Project # : 2004039
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Funding Source(s):

State Pooled Funds

Task Update:

1 Project Management

Project management involves coordinating state activities (between states participating in this pooled fund study and with the national IDS program), scheduling the driver interface workshop, and disseminating research results to participating states. Travel coordination and management for the kickoff, biannual project meeting, and design workshops will be handled by Mn/DOT.

Deliverables : Coordination of research and design workshop activities, results dissemination, and periodic project reporting. Pooled fund states will be kept informed of developments and results through task summary reports

Task Budget : $36,193.00

Task Due Date : 12/31/2008 *(Calculated)*

Date Delivered : *(Reported by PI)*

Date Approved : *(CTS received task approval)*

Task Approved : No

Progress:
1. Coordinated with GA.
2. Tried to arrange for data collection in NH, but citizen objections and other priorities within NHDOT forced the cancellation of the NH data collection effort.
3. Continue to work with CA and NV to provide CH2MHill the data it needs to analyze and identify candidate intersections for data collection.

2 State Crash Analysis

Crash analysis consists of two key components: the development of a methodology by which intersection crashes can be reviewed and the development of statistical models which relate the characteristics of a rural stop-controlled intersection to that intersection's crash experience. With respect to the former, relevant crash data was used to determine which crash configurations and intersection types lead to high frequency and severity of crashes. Intersections having crash rates higher than the critical rate were identified as potential candidates for intersection research. Further analysis led to the selection of a candidate experimental intersection. This work is complete in Minnesota; the report documenting this analysis is presently in press. The statistical models relating the characteristics of a rural stop-controlled intersection to that intersection's crash experience will be used to identify intersections which are atypically dangerous or safe. To also identify the characteristics associated with atypically high or low crash experiences, and ultimately to estimate the potential safety impacts of the proposed intersection decision support system. This work is still in progress. For member states analyses focused on identifying critical rural intersections using the critical crash rate and severity measure methodology will be performed by the Minnesota team. The Minnesota team will request specific crash information from the crash database in each state. The Minnesota team will then provide to each state a list of intersections with crash rates and severities above the critical level as well as a recommendation for the experimental intersection. In the even that some states lack particular data in their crash reporting/recording systems, modifications to the analysis developed for the national IDS project will be made to best compute similar statistics

Task Update:

Deliverables : Reports summarizing the rural intersection crash problem in each member state, a list of rural intersections with crash rates above the critical level, and a recommendation for an intersection to be instrumented and studied further. Techniques and methodologies developed for the national IDS project will be used to analyze state crash databases

Task Budget : $150,000.00

Task Due Date : 2/2/2005 *(Calculated)*

Date Delivered : *(Reported by PI)*

Date Approved : *(CTS received task approval)*

Task Approved : No

Progress: NH crash analysis was complete. Working to collect the CA and NV data needed to identify candidate intersections. Once candidate intersections are identified, site visits will be conducted so as to make final recommendations.

3 Intersection Design Workshops

A key element of the rural IDS system is the driver-infrastructure interface, which will convey relevant intersection state data to the driver attempting to enter or cross the traffic stream. The goal of the IDS program is to develop a nationally deployable system. Design input from member states will be sought.Two interactions with the representatives from each member state are planned. The first interaction will be a design brief describing the proposed driver infrastructure interface(s). This design brief will be provided to each of the participating states; a review/critique of the proposal will be requested. Feedback provided by participants will be used to determine which interface(s) will be replicated in the HumanFIRST driving simulator. Once the interface design set has been defined, a workshop will be held for representatives of the participating states. In this workshop, participants will have the opportunity to experience the interface in the University of Minnesota HumanFIRST driving simulator. Participants again will have the opportunity to critique the interface, and and provide design recommendations based on their experience. The final interface design will take into account the feedback produced by the design workshop. Once the design is "finalized," it will be tested under the national IDS contract in the HumanFIRST driving simulator to determine driver response and acceptance.

Deliverables : A prototype design drawing sn specification for a rural IDS driver-infrastructure interface that will satisfy national constraints with respect to deployment, maintenance, and public and Manual on Uniform Traffic Control Devices (MUTCD) acceptance points of view.

Task Budget : $19,781.00

Task Due Date : 10/2/2004 *(Calculated)*

Date Delivered : 3/1/2006 *(Reported by PI)*

Date Approved : *(CTS received task approval)*

Task Approved : No

Progress: Complete.

4 Development of a Portable Intersection Surveillance System

The Minnesota team will develop a portable intersection surveillance system to be used to collect driver behavior data at remote, rural intersections. This system will be based on the rural intersection surveillance system developed for and operating at the intersection of US 52 and CSAH 9 in Goodhue County, MN.

The portable surveillance system will be composed of four primary subsystems:
·Radar Stations (for mainline traffic surveillance, including wireless data transmitters)
·Lidar stations (for both vehicle classification and median vehicle trajectory tracking, including wireless data transmitters)
·Main Computer Station (central control computer, Data Acquisition System, housed in a lockable trailer, and a single video camera to capture unusual events at the intersection crossroads)
·Power distribution system (including generators, transformer, auxiliary fuel tanks, cables, and automatic starting system (for battery charging), contract electrician , and an ATV to assist with system set up at each state site).

Task Update:

Two primary differences exist between the fixed and portable surveillance systems: power distribution and data transmission. To minimize the number of refueling trips needed by the state DOTs to keep the system running, a battery/generator system is proposed. With this system, each sensor station will be powered locally by a 12 Volt, deep cycle battery, which in turn is connected to battery charger. This battery charger is connected to a portable generator. The generator is connected to a Programmable Logic Controller (PLC) which has an internal clock. Two or three times per day, the PLC will instruct the generator to start. The generator will energize the battery chargers, which will in turn charge the batteries. After the generator runs a sufficient amount of time to charge the batteries, the PLC will shut down the generator. The process will be repeated as needed to keep the batteries sufficiently charged. A diagram of one leg of the power distribution system is shown in Figure 1 below.

Data transmission at the Minnesota test intersection is performed with a local DSL network using hardwired CAT V conductors. For the portable intersection surveillance system, wireless communication is proposed to control both the cost and the complexity of the portable system. A number of variations of 802.11a, b, and g as well as Mesh Networks will be tested at the Minnesota test intersection to identify an optimal technology for this portable surveillance system application.

Once power distribution and data transmission systems are validated, the portable surveillance system will be tested alongside the Minnesota test intersection instrumentation to validate the system performance (accuracy, reliability, data transmission robustness, etc.), fuel economy, and battery charge and discharge rates. Once the system performance and operating conditions are known, the system will likely be deployed initially in Wisconsin. The intersections identified in the Wisconsin crash analysis are on US 53, and are reasonably close to the University of Minnesota. Because of this proximity, periodic checks of this initial deployment are relatively convenient for the Minnesota team.

Deliverables : The deliverable for this task will be a portable rural intersection surveillance system which will be transported to partner states for the purpose of recording driver behavior at intersections jointly selected by each partner state and the Minnesota team.

Task Budget : $195,000.00

Task Due Date : 7/2/2005 *(Calculated)*

Date Delivered : 4/1/2006 *(Reported by PI)*

Date Approved : *(CTS received task approval)*

Task Approved : No

Progress: Complete.

5 Data Collection

Data will be collected with the portable surveillance system for approximately one month at one intersection per partner state. The Minnesota team will work with each state to identify the intersection at which data will be collected. Once the intersection is known, the Minnesota team will arrange for the portable system to be shipped to a state DOT facility close to the intersection. Once the equipment arrives, Minnesota personnel will travel to the DOT facility, pick up the equipment, and bring the portable system on line. State DOT personnel will assist with this process by providing and installing sensor posts at locations determined by the Minnesota team. State DOT's will also provide a means to secure portable equipment at the intersection to discourage theft or vandalism.

The expected time to bring the system on-line and test its performance is one week. At the conclusion of the first week, the Minnesota Team will turn the portable system over to the state DOT, who will refuel generators when needed, periodically check for component theft or vandalism, and in the unlikely event, reboot either the intersection controller or data acquisition computer. (The need to reboot has not been an issue with the permanent system.)

At the conclusion of the data collection process, the Minnesota team will return to the test site, take the system off-line, and prepare to ship it to its next destination. Data collected at the intersection will be archived at the University of Minnesota for subsequent analysis.

Deliverables : At least one month of driver behavior data collected in each partner state. The data will be archived and analyzed on a per state basis. Analysis includes gap acceptance statistics as functions of time of day, vehicle class, maneuver type, and speed variation along mainline roads. The results of the analysis will be summarized for each state in a letter report.

Task Budget : $58,571.00

Task Update:

Task Due Date : 8/31/2008 *(Calculated)*

Date Delivered : *(Reported by PI)*

Date Approved : *(CTS received task approval)*

Task Approved : No

Progress: During this quarter, NC data collection was completed, and Georgia data collection was completed. The plan was to move to NH next, but problems within NH DOT prevented the deployment of the surveillance system.

6 Data Analysis

The construction of a number of experimental rural intersections spread throughout the country will enable the creation of a rich nationally relevant database characterizing driver behavior at rural expressway intersections. The database will be unique in the transportation field, and can provide researchers a significant resource for traffic engineers and researchers. Specific to this project will be the opportunity to determine whether statistically relevant regional differences exist in the gaps drivers accept and the trajectories taken to enter the mainline traffic stream. If differences are found to exist, quantification of these differences can be used to determine the degree to which the baseline rural IDS system needs to be modified to accommodate these differences. The data to be collected (and subsequently analyzed) is extensive. In addition to sensing the traffic approaching the intersection, traffic leaving the intersection will be sensed as well. By providing surveillance in this direction, collisions and near-misses will be captured, and will provide a baseline against which the IDS system can be evaluated when it is deployed. Vehicle identification systems located at each test intersection will provide macroscopic descriptions of vehicles entering the traffic streams; passenger vehicles will be distinguished from trucks, farm equipment, etc. If the resolution of the vehicle identification system is sufficient, it may be possible to distinguish large passenger vehicles from smaller vehicles, SUVs, pick-up trucks, etc. (Vehicle classification systems are under study as part of the Minnesota IDS study.) Sensors aimed at the crossroads will also record the trajectory of each vehicle as it leaves the minor road and enters the traffic stream. This information, combined with the vehicle classification data, will provide thorough behavioral models of gap acceptance and driver trajectories as a function of vehicle type.

Deliverables : A rich national database describing the behavior of drivers at rural expressway intersections. Analysis of the data collected at the state intersections will be used to determine whether statistically relevant regional differences exist regarding how drivers accept gaps and enter the traffic stream. If differences do exist, they will be quantified to determine which, if any, modifications to the DII and the algorithms which trigger it need to be modified to accommodate these regional differences. A report summarizing the results of the data analysis, and quantification of regional differences in driver behavior will also be provided.

Task Budget : $38,955.00

Task Due Date : 12/31/2008 *(Calculated)*

Date Delivered : *(Reported by PI)*

Date Approved : *(CTS received task approval)*

Task Approved : No

Progress: This is on-going. It requires about three weeks to process state data. Considerable error checking is performed to ensure that results are correct.

WI has been processed, and MI is in process. Once MI is complete, IA, NC, and GA will follow. Once CA and NV data has been collected, it, too, will be processed.

Future Plans:

1. Crash analysis for CA and NV intersections (work to be done by CH2MHill).
2. Instrumentation of the CA and NV intersections.
3. Completion of the data processing from the remaining states.

Problems Encountered/Actions Taken:

1. Not being able to instrument the NH intersection was disappointing. A significant effort in a short time frame was invested in the NH sites.

2. Acquiring crash record data in CA and NV has proven problematic. With NV, it is a dearth of intersections sufficiently high traffic volumes and crash frequencies; with CA, it has been answers to questions regarding data which has been provided. As has been in the past, persistence will overcome.