Southwest Region University Transportation Center
Project Proposal - FY 2012

TITLE OF PROPOSED PROJECT: MANUAL TRAFFIC CONTROL FOR PLANNED SPECIAL EVENTS AND EMERGENCIES

STRATEGIC GOAL(S) ADDRESSED: EVACUATION

CONSORTIUM MEMBER: LSU

TOTAL PROJECT BUDGET: $81,181

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HAS THIS PROPOSAL BEEN SUBMITTED FOR FUNDING ELSEWHERE? NO

DID THIS PROPOSAL RECEIVE FUNDING FROM ANOTHER SOURCE? NO

DOES THIS PROPOSED RESEARCH INVOLVE THE USE OF HUMAN SUBJECTS? NO

WILL THIS PROPOSED RESEARCH INVOLVE OTHER ORGANIZATIONS AS PARTNERS?* NO

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ABSTRACT OF PROJECT: To understand and find ways to improve traffic control techniques during emergencies, this research aims to analyze and evaluate the use of manual traffic control. To put it plainly, at present no one can quantify the effect manual traffic control has on intersection operations. Despite being widely used both in the United States and abroad, the impact of manual traffic control has never been quantified from a scientific or engineering standpoint. The goal of this research is to conduct a quantitative analysis on the impact of manual traffic control on isolated intersections using empirical data. This research seeks to determine when it may be more beneficial to use police in lieu of signalized control, when it should be used, where it can best be implemented, and how it could be simulated for the purpose of evaluating its effect on the overall movement of traffic during emergencies, events, or routine traffic conditions.

MANUAL TRAFFIC CONTROL FOR PLANNED SPECIAL EVENTS AND EMERGENCIES

Project Problem Statement

Manual traffic control is a common intersection control strategy whereby trained personnel, typically police law enforcement take over the responsibility of allocating intersection right-of-way. The need for manual control is typically associated with abnormally high, unbalanced, or widely varying traffic demand. Although such conditions can occur at any time, they are most apparent before and after special events and emergencies. To understand and find ways to improve traffic control techniques during emergencies, this research aims to analyze and evaluate the use of manual traffic control. To put it plainly, at present no one can quantify the effect manual traffic control has on intersection operations. Despite being widely used both in the United States and abroad, the impact of manual traffic control has never been quantified from a scientific or engineering standpoint. The goal of this research is to conduct a quantitative analysis on the impact of manual traffic control on isolated intersections using empirical data. This research seeks to determine when it may be more beneficial to use police in lieu of signalized control, when it should be used, where it can best be implemented, and how it could be simulated for the purpose of evaluating its effect on the overall movement of traffic during emergencies, events, or routine traffic conditions.

Background

The effectiveness of police control can vary widely depending on local conditions. While officers are able to observe traffic directly, they have limited ability to coordinate with upstream and downstream signals and may be inconsistent on the allocation of right-of-way. Their effectiveness and methods are also largely a function of their training and the techniques that are used in their local communities.

2.1 Police Traffic Control Training:

Specialized training for law enforcement officers in the field of traffic control first emerged in 1947 (Hoover, 1947). As director of the Federal Bureau of Investigations (FBI), J. Edgar Hoover institutionalized uniform training programs and training templates for police traffic control. These FHI reports (Hoover, 1947) discuss the FBI's role in instituting training for law enforcement traffic control and the need for the enforcement of traffic laws. By 1950, enforcement of traffic laws had emerged as a major concern for law enforcement nationwide (Hoover, 1950). As a result, the FBI began conducting local police training and reviewed specialized traffic schools for law enforcement officers. The FBI's police traffic training program as of 1950 describes various programs dealing with the broader role of police officers and traffic and not with the identification of PTCPs (Hoover, 1950).

In 1973, the United States Department of Transportation's (USDOT) National Highway Traffic Safety Administration (NHTSA) developed the "Basic Training Program for Police Traffic Services"(Hale and Hamilton, 1973). The goal this program was to improve the effectiveness of the National Highway Safety Program by establishing national standards on jurisdictional law enforcement training to provide police officers with basic, uniform training in police traffic services. This national training program was targeted at six major areas; policy and traffic service, traffic law, traffic direction and control, traffic law enforcement, traffic management and traffic court. The "Traffic direction and control" segment of the

training program states that an officer has three goals when directing traffic, safe movement of vehicles and pedestrians, the mitigation of traffic congressing and ensuring driver comply with traffic laws. The training program also discusses instances where police traffic control should be used, areas of periodic congestion (rush hour choke points), special events and around hazardous scenes. However, the training program does not include guidance in determining when it may be more beneficial to use police in lieu of signalized control, when it should be used, where it can best be implemented or how to evaluating its effect on the overall movement of traffic during emergencies, events, or routine traffic conditions.

Over the years, numerous other manuals have been developed to describe the proper functioning of police traffic control (Hoover, 1947; Hoover, 1950; Leonard, 1973; Hale and Hamilton, 1971; Weston, 1996). However, these documents focus primarily on the role of police in accident reduction, selective traffic law enforcement and the development of a traffic orientated police force. They also provide guidelines for officer safety, by identifying where and how to move within a congested intersection. The report by Weston (Weston, 1996) provides a comprehensive guideline for ensuring safety and efficiency while directing traffic, but it still does not specify when it may be more beneficial to use police in lieu of signalized control, when it should be used, where it can best be implemented or how to evaluating its effect on the overall movement of traffic during emergencies, events, or routine traffic conditions. With regard to the where police should be located, the article simply states that "Available police should be assigned to key intersections and merging points…" but, once again, it does not specify how these points should be selected or how many officers should be used.

Numerous other manuals exist for law enforcement which emphasizes the importance of proper training with regard to intersections traffic control (FHP, 1996; Shults, 2005; Jones, 2008). Generally, however, these types of manuals are structured for "in house" use of the department authored by a senior officer. The guidelines they contain also deal with officer safety while directing traffic. They do not, however, give specific criteria for strategic selection of intersections at a network level to facilitate a safe and effective egress/ingress during events or emergencies. Nor do these articles any great insight into when and how officer should allocate right-of-way.

2.3 Evacuation and Intersection Control

Evacuations traffic management plans rely heavily on predetermined evacuation routes (DHS, 2009). Recently, there have been studies that have developed and tested algorithms to find optimum routing and signal timings for corridors under evacuation conditions (DDOT, 2006; Chen and Liller-Hooks, 2007; Parr and Kaisar, 2011). However, the role of police in traffic control was not taken into account in these studies.

A study conducted by Liu et al. (2008) developed a multifaceted traffic control system for urban evacuation which incorporates vehicle routing, contraflow strategies, staged evacuation and optimal signal timing (Liu et al., 2008). This research used a genetic algorithm based heuristic to locate the critical intersections within evacuation corridors and optimize their signal timings. Similar work was carried out by Durak et al. (2009) and Jabari et al. (2009) to develop optimization tools to find the optimal intersection control locations and strategies for a simulated evacuation (Durak and Goodman, 2009; Jabari and Liu, 2009). However, these studies only compare their developed strategies against existing pre-timed, semi-actuated or fully actuated controls and not manual traffic control, which in the case of special events and evacuations is more likely to be the control strategy implemented at key intersections. Therefore, it is unknown if the developed strategies would be more beneficial.

Objectives of Study

The goal of this research is to conduct a quantitative analysis on the impact of manual traffic control on isolated intersections using empirical data. This research seeks to determine when it may be more beneficial to use police in lieu of signalized control, when it should be used, where it can best be implemented, and how it could be simulated for the purpose of evaluating its effect on the overall movement of traffic during emergencies, events, or routine traffic conditions.

1. Conduct a full review of the existing body of knowledge on manual traffic control from both transportation and police research areas.
2. Observe and record a statically relevant sample of isolated intersections under manual traffic control.
3. Quantify pertinent variable data from the recorded intersection under manual control.
4. Identify the statistically significant independent variables contributing to phase length and sequence.
5. Mathematically replicate the observed officer behavior using logistical regression (logit).
6. Create statistically similar intersections for each case study in a microscopic traffic simulator.
7. Program the developed logit model into the traffic micro-simulation environment.
8. Compare the simulated manual traffic control of the study intersections to the current signal traffic controller deployed in the field.

Work Plan

Task 1: Literature Review
A complete literature review encompassing the breadth and depth of knowledge in the field, both state-of-the-art and state-of-the-practice will be conducted.

Task 2: Collect Data
Observe and record a statically relevant sample of isolated intersections under manual traffic control. Using throughput as the key variable for a given time frame, the sample size should corresponding to ±10% at 95% confidence level.

Task 3: Assessment of Pertinent Data
Quantify pertinent variable data from the recorded intersection under manual control using an extensive database of officer actions and potential stimuli. Variables with strong and weak correlation will be measured using an α p-value of 0.05 and 0.1, respectively.

Task 4: Replication of Officer Behavior
Mathematically replicate the observed officer behavior using logistical regression (logit). The goodness-of-fit of the model will be represented with a ρ^2 value no less than 0.25.

Task 5: Create Statistically Similar Intersections
Create statistically similar intersections for each case study in a microscopic traffic simulator. Use goodness-of-fit measures such as regression analysis with p-values no less than 0.75 and comparison test such as T-test and/or ANOVA.

Task 6: Program Logit Model

Program the developed logit model into the traffic micro-simulation environment. A statistical analysis comparing simulated throughput and capacities of case study intersections and observed values.

Task 7: Comparison of Results

Compare the simulated manual traffic control of the study intersections to the current signal traffic controller deployed in the field. The collection and statistical analysis of intersection throughput will be compared with the capacity under both scenarios.

Schedule of Activities

	Year 2013/2014																	
	Jun-13	Jul-13	Aug-13	Sep-13	Oct-13	Nov-13	Dec-13	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14
Task 1																		
Task 2																		
Task 3																		
Task 4																		
Task 5																		
Task 6																		
Task 7																		

Deliverables

A final report documenting the entire research effort, including the methodology used in the research, conclusions drawn from the research, and recommendations for future research and implementation plan will be submitted. Ultimately, these techniques and results would be adapted for use in other locations around the U.S. (and internationally) and for other types of evacuation scenarios.

Plan to Pursue Additional Funding after Conclusion of SWUTC Project

At the conclusion of this project, actions will be taken to extend the research effort. These actions may include examining ways to apply this research to other events around the world. Potential sponsors for the additional research may include Louisiana Department of Transportation and Development.