Southwest Region University Transportation Center
Project Proposal - FY 2012

TITLE OF PROPOSED PROJECT: CALIBRATION OF THE LOUISIANA HIGHWAY SAFETY MANUAL

STRATEGIC GOAL(S) ADDRESSED: SAFETY

CONSORTIUM MEMBER: LSU

TOTAL PROJECT BUDGET: $150,000

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HAS THIS PROPOSAL BEEN SUBMITTED FOR FUNDING ELSEWHERE? NO

DID THIS PROPOSAL RECEIVE FUNDING FROM ANOTHER SOURCE? NO (MATCH FUNDING ONLY)

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

WILL THIS PROPOSED RESEARCH INVOLVE OTHER ORGANIZATIONS AS PARTNERS?* YES (LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT)

PROJECT MONITOR NAME, ORGANIZATION, ADDRESS AND TELEPHONE NUMBER:*
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ABSTRACT OF PROJECT:
The State of Louisiana consistently ranks near the bottom in national statistics regarding highway safety, particularly traffic crash related fatalities. To counter these conditions, the Louisiana Department of Transportation and Development (DOTD) has initiated several programs over the recent decade. The past several decades have also seen many new highway safety related innovations on a national-level. One of the most promising recent developments

has been the recent publication of the Highway Safety Manual (HSM) by the American Association of State Highway and Transportation Officials (AASHTO). The HSM includes analytical tools and techniques for quantifying the safety effects of planning and design alternatives and configurations and operations and maintenance decisions. However, since the HSM has been developed based on national trends and statistics, it must be "adjusted" for local use. These adjustments allow it to better fit local conditions. The objective of this project is to calibrate the Part C predictive model as outlined in Appendix A of the Highway Safety Manual for roadway segments in Louisiana, specifically, Rural Two-Lane-Two-Way Roads; Rural Multilane Highways; and Urban and Suburban Arterials. A single calibration for each of the aforementioned roadway segments will be conducted and applicable to the entire state of Louisiana. In addition, a comparative analysis will be conducted to compare the SPFs developed specifically for Louisiana to the SPFs determined as a result of calibrating the current HSM models to Louisiana conditions. Among the outcomes of this research will be to recommend whether the Louisiana DOTD should use the state specific SPFs or the calibrated SPFs for future projects.

Calibration of the Louisiana Highway Safety Manual

A proposal submitted to:

Louisiana Transportation Research Center

by:

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Calibration of the Louisiana Highway Safety Manual

PROBLEM STATEMENT

The State of Louisiana consistently ranks near the bottom in national statistics regarding highway safety, particularly traffic crash related fatalities. To counter these conditions, the Louisiana Department of Transportation and Development (DOTD) has initiated several programs over the recent decade, among these is the Louisiana Strategic Highway Safety Plan (SHSP). The goal of this program is to reach "Destination Zero Deaths" on Louisiana roadways by reducing the human and economic toll on Louisiana's surface transportation system through various collaborative efforts and an integrated 4E approach (Education/Enforcement, Engineering and operations, Emergency Services, Everyone Else!).

The past several decades have also seen many new highway safety related innovations on a national-level. One of the most promising recent developments has been the recent publication of the Highway Safety Manual (HSM) by the American Association of State Highway and Transportation Officials (AASHTO). The HSM includes analytical tools and techniques for quantifying the safety effects of planning and design alternatives and configurations and operations and maintenance decisions. However, since the HSM has been developed based on national trends and statistics, it must be "adjusted" for local use. These adjustments allow it to better fit local conditions. This calibration can be accomplished in a number of ways, including through the development and application of safety performance functions (SPFs) that use locally prevailing crash data and other data that will reflect and account for area-specific variations in traffic patterns, climate, topology, etc. One of the primary goals of this project will be to calibrate the HSM for use in Louisiana.

CURRENT LITERATURE AND RELATED STUDY

Since the initial publication of the HSM, several states have undertaken research and calibration efforts to localize it to specific areas. Among them are Maryland, North Carolina, Georgia, Oregon, and Alabama. In Maryland, local calibration factors and procedures were developed to predict crash conditions for sites throughout the state (6). In North Carolina, the prediction models in Part C of the HSM were calibrated using state-specific data (1). The objective of the North Carolina effort was to develop SPFs for different types of facilities in North Carolina, then illustrate how they can be used to improve the decision making process. In Alabama, the state DOT is currently working with the University Transportation Center (UTC) at the University of Alabama to conduct research on the optimization and implementation of the HSM methodologies, the Federal Highway Administration's (FHWA) supporting software Safety Analyst (SA), and the Interactive Highway Safety Design Model (IHSDM) (5). The Georgia and Oregon DOTs have both been early adapters of the HSM. In both of these states, comparison calibration factors and crash patterns have been developed to understand the

adaptability of default SPFs from other states as well as for different locations within within each state (3). In addition to the study proposed here, there have also been other prior efforts to calibrate SPF in Louisiana. Specifically, research by Sun et al (4) has used crash data to calibrate the SPF for Louisiana-specific rural multilane highways by investigating how the calibrated models work in the network screening and identifying the potential application issues.

OBJECTIVES OF RESEARCH

The objective of this project is to calibrate the Part C predictive model as outlined in Appendix A of the Highway Safety Manual for roadway segments in Louisiana, specifically, Rural Two-Lane-Two-Way Roads; Rural Multilane Highways; and Urban and Suburban Arterials. A single calibration for each of the aforementioned roadway segments will be conducted and applicable to the entire state of Louisiana. In addition, a comparative analysis will be conducted to compare the SPFs developed specifically for Louisiana to the SPFs determined as a result of calibrating the current HSM models to Louisiana conditions. The development of the Louisiana specific SPFs will be performed by others and is not part of this scope of work. Among the outcomes of this research will be to recommend whether the Louisiana DOTD should use the state specific SPFs or the calibrated SPFs for future projects.

At a minimum, the following tasks will be completed to satisfy the research objectives:

1. Literature and State-of-the-Practice Review
2. Data Collection and Analysis
3. Prepare and present the project review committee with an interim report
4. HSM Calibration
5. Comparative Analysis
6. Final Report

METHODOLOGY

The process below outlines the proposed steps necessary to achieve state specific calibration for Louisiana.

Step 1 – Identify the facility types for which the applicable Part C predictive model is to be calibrated. The facility types identified for this project include the following: rural two lane, two way roads; rural multilane highways; and urban and suburban arterials.

Step 2 – Select sites for calibration of the predictive model for each facility type. A minimum of 30-50 sites within each facility type will be selected in consultation with DOTD staff. The site selection process will be random and not biased towards high or low crash frequencies at each site. The final selection of calibration sites should collectively represent a minimum of 100

crashes per year. Due to a relatively consistent terrain and climate in Louisiana, a single calibration will be performed for the entire state. It is assumed that all data required for the project including relevant road characteristics and crash data will be available for each of the study sites and for use by the investigators by month 3 of the project. Where a complete set is not available, it is assumed that the investigators will work with DOTD staff to create a mutually agreeable data pool.

Step 3 – Obtain data for each facility type applicable to a specific calibration period. For each facility type, site characteristic data should be suitable and meet all of the requirements as stated in Table A-2 of the HSM Appendix A. The calibration data set should include the total observed crash frequency for one or more years. Observed crashes of all severity levels will be included. Detailed crash data including crash severity, collision type, drive-way related crashes, and nighttime crash information would facilitate a higher level of analysis for the calibration. It is assumed that the required data will be readily accessible from DOTD sources. Where appropriate, Google Streetview imagery may be used to confirm missing elements, such as driveway locations. However, it is expected that this would be a very minor effort.

Step 4 – Apply the applicable Part C predictive model to predict total crash frequency for each site during the calibration period as a whole. The appropriate predictive method shall be applied to the calibration data sets compiled in the previous step. As a result, the expected average crash frequencies will be determined. Microsoft Excel spreadsheets will be developed to run predictive models for the entire group of sample sites.

Step 5 – Compute calibration factors for each facility type, as indicated in Part C of the HSM predictive model. A separate computation will be performed for each facility type.

Comparative Analysis

A comparative analysis will be conducted to compare the Louisiana SPFs, prepared by others, to the calibration factors developed as part of this project. The comparison will determine if any variations exist within the data sets.

Statistical Analysis Support

Since crash frequency data may vary substantially between time periods, it is critical to ensure the variations within data are not misinterpreted. To lessen the potential for analytical errors and quantify the level of confidence of the research results, statistical methods can be employed to compensate for these shifts in data. The Empirical Bayes Method is best suited for the circumstances presented in the HSM.

As part of the project, the investigators will rely on two sources of external expertise during the development of the data sets and analysis of the results. The first is the free statistical consulting services from the LSU Department of Experimental Statistics. The department provides a free on campus statistical consulting service to faculty, staff, and

students affiliated with the University, which will be utilized to perform the statistical analyses necessary to complete this project. The second will involve periodic meetings with Dr. Helmut Schneider. Dr. Schneider's involvement will be supported through existing contracts with the DOTD and will not require funds dedicated specifically from this project.

Future Work

As future changes occur such as vehicle technology or engineering treatments, it is recommended that the SPFs and calibration factors be periodically redeveloped or recalibrated accordingly (1). The SPFs may either be redeveloped in the future or a calibration factor can be calculated for each future year. While not part of this project, it is worth noting the importance of these updates for future analysis.

WORK SCHEDULE

It is proposed that the project will be completed within a period of 18 months (June 1, 2012 to December 31, 2013). In order to complete the comparative analysis of the Louisiana SPFs and the calibrated model, the Louisiana specific SPFs shall be received by the beginning of month 11 of the project.

Task	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Lit. Review																		
2. Data Collection																		
3. Prepare/Present Interim Report																		
4. HSM Calibration																		
5. Comparative Analysis																		
6. Final Report																		

STAFFING PLAN

The project will be completed under the direction of Dr. Brian Wolshon. Dr. Wolshon is a Professor in the Department of Civil and Environmental Engineering at Louisiana State University, specializing in the field of highway design and traffic engineering. His research covers several areas in highway transportation, most notably issues related to the planning and management of traffic during mass evacuations and in particular the application of reversible traffic operations, the acquisition of road-weather information and the development of regional micro-scale evacuation traffic models of various metropolitan areas.

It is also anticipated that the primary work tasks will be completed by a research specialist and a graduate student. The research specialist, Katie Spansel, will be responsible for the day-to-day development and management the project efforts including, gathering data and related literature; conducting research and analyses; providing oversight and guidance to the graduate student; and writing the report of research report findings. The graduate student will

be employed to develop models, analyze data findings, and create spreadsheets. It is also assumed that the methods and outcomes developed from this project will also be used to support a doctoral dissertation and a master's thesis.

DELIVERABLES

At the approximately half-way point of the project, an interim report will be prepared and presented to the project review committee. The interim report will detail the information gathered in Tasks 1 and 2 and recommend a work plan and schedule to complete the project. A final report will be prepared to document the entire research effort. The draft final report will be submitted to LTRC three months prior to project completion for review and recommendations. A benefit assessment will be included for future marketing purposes. The research results will be presented to the project review committee and the LA DOTD. Lastly, the data files will be compiled appropriately to ensure ease of use for future data updates or applications.

AMOUNTS REQUESTED BUDGET JUSTIFICATION

The total amount requested to complete the proposed items of work described herein is shown on page 8 of this proposal. It is estimated that all work items will be completed for a cost of $150,000. The cost summary table details the cost for specific labor, equipment, travel and overhead expenses. The cost summary table reflects the budget amounts and funding sources as follows: $75,000 from UTC funds; $49,500 from university cost share; and $25,500 from LTRC cost share. An explanation for each of the items in the table is also included in the sections below.

A. Personnel

Salary for Brian Wolshon (Principal Investigator) includes approximately three months over the duration of the project. Salary for Katie Spansel includes approximately six months for the duration of the project. The investigators will use this time to determine whether to calibrate the existing data in the HSM or develop safety performance functions that are specific to Louisiana. After a literature review, the project investigators will collect data including, but not limited to, crash data, road geometry information, and traffic volume data. In addition, these funds will be allocated to analyze the output from the data collection, write reports, and produce publications for submission to peer-reviewed journals.

B. Graduate Student Personnel

Support for one graduate research student over the duration of the project is requested. The appointment for the graduate student will be made at a rate of $12,000 per academic year for a total of $18,000 over the duration of the project. The graduate student will assist

the investigators in the completion of the proposed project and will use elements of the project to complete the requirements for his/her degree.

C. Fringe Benefits

Fringe benefits are charged as 36% of the salary of the investigators.

D. Operating Expenses

Operating expenses include materials, supplies, and travel. Funds will also be allocated for the purchase of items required to complete the tasks within the proposed project scope. Support funds are also requested for consumable equipment to facilitate the organization, storage, and/or collection of data as well as expendable supplies such as computer disks, binders, and notebooks.

Travel money has also been included to defray the cost of travel to professional conferences and meetings to present the results of research conducted under the grant. Travel funds will be used to present results of our analyses to local officials in Louisiana and at professional meetings. It is anticipated that the most likely conference that will be attended would be the annual Transportation Research Board conference in Washington D.C.

E. Indirect Costs

Indirect costs on LSU match funds will be charged at federally negotiated rate of 48% of the modified total direct cost (MTDC). It should be noted, however, that the reduced rate of 24% is charged for USDOT/UTC funds.

In total, the cost of the project is estimated to be $150,000. It is requested for LTRC to provide $25,500 in cost sharing.

PURSUIT OF FUTURE FUNDING

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 Louisiana and/or developing similar quantitative methods for other road functional classifications. Potential sponsors for the additional research include Louisiana Department of Transportation and Development.

References

1. Srinivasan, R; and Carter, D. “Development of Safety Performance Functions for North Carolina,” Final Project Report. University of North Carolina Highway Safety Research Center, 2011.

2. Saito, M; Brimley, B; and Schultz, G. “Volume 2: Calibration of the Highway Safety Manual and Development of New Safety Performance Functions,” Final Project Report. Utah Department of Transportation, 2011.

3. Xie, F; Gladhill, K; Dixon, K.; and Monsere, C. “Calibration of Highway Safety Manual Predictive Models for Oregon State Highways,” Final Project Report. Oregon State University School of Civil and Construction Engineering, 2011.

4. Sun, X; Li, Y; Magri, D; and Shirazi, H.H. “Application of "Highway Safety Manual" Draft Chapter: Louisiana Experience” Draft Report. Louisiana Department of Transportation, 2006.

5. Barnett, T. "Scoping Study for Implementation of the Highway Safety Manual in Alabama," Interim Report. Alabama Department of Transportation, 2011.

6. Barnett, "The Development of Local Calibration Factors for Implementing the Highway Safety Manual in Maryland," Interim Report. Maryland Department of Transportation, 2011.