Identifying Number MPC-345

Project Title:

Systems Analysis to Improve Local Road Safety: Phase I

University:

North Dakota State University

Principal Investigator:

Dr. Kimberly Vachal
Program Director - RTSSC
Advanced Research Fellow
Phone: (701)231-6425

Kurt Johnson
Program Director - DOTSC
Associate Research Fellow
Phone: (701)231-7230

Description of Research Problem:

Highway safety is a priority in ensuring social and economic connectivity, especially in rural states such as North Dakota where population is widely dispersed. The challenges of proactive decisions with regard to road safety are intrinsic to the nature of crashes, which are largely episodic. The urban-based decision models, which rely on crash counts and high traffic volumes to produce defensible safety investment plans, often fall short in fulfilling states' needs when applied as system-wide decision support systems where substantial road geography is in lower density traffic areas. Need is evident in the limited obligation of High Risk Rural Roads Program (HRRRP) funds in western states (FHWA 2010). The need is further extenuated considering the high percent in rural run of the road accidents occurring on rural highways at both the state and county levels. In many instances county level safety programs are non-existent except in a reactive effort.

The rural U.S. plays a significant role in furthering transportation safety and security for the nation as a whole. Rural road traffic safety has been identified as a key to reducing road death and injury by the U.S. DOT. Five focus areas within an agency-wide rural roads safety effort were announced the Rural Safety Initiative. These included Safer Drivers, Better Roads, Smarter Roads, Better Trained Emergency Responders, and Outreach and

Partnerships (U.S. DOT 2008). U.S. Transportation Deputy Secretary Thomas J. Barrett stated that "Making one road safer is important. But making rural roads around the country less deadly is absolutely essential" in discussing grant awards under the Rural Safety Innovation Program. This program and others, such as FHWA the Highway Safety Improvement Plan (HSIP) and the HRRRP, promote data collection and evaluation for safety improvements on dangerous and oft neglected rural roadways. The research proposed here would make a valuable contribution in exploring systematic approaches for this effort.

The low-volume local road network has received little attention in national models that rely primarily on crashes and annual vehicle miles traveled (AVMT) as the predictor variables (Kononov 2009). Additionally, fatalities – traditionally the core measurement in crash analysis and project decision criteria – are rare and random events in rural states, which make them a weak predictor when considering decision validation and shorter-term infrastructure investment decisions. Therefore, the need in rural settings for a flexible derivative of working safety program platforms, to utilize existing data, is evident. Safety must be a proactive program if it is to yield benefits on lower volume roads.

Road safety is influenced by multiple factors such as roadway design and operations, vehicle safety systems, occupant behaviors, and environmental factors. A research thrust in roadway design and operations over recent years has been to develop systematic, empirical decision systems applicable to safety investments. Several alternatives are available to integrate local roads into these efforts. Comparative performance measures and best practices identified through fatal crash analysis may offer some basis for problem identification and countermeasure selection (American Association of State Highway and Transportation Officials 2009). Improved prediction models for estimating future crashes and the effects of accident modification factors (AMF) have also been offered as in element in this effort (Candia 2009, Dimaiuta 2009).[1] Quasi-induced risk ratios and incidence rates should also be considered as tools in rural roads safety performance (Stamatiadis and Deacon 1997, Lyman 2002, Li 2002, Li et al. 2003, Chandraratna and Stimatiadis 2009).

[1] The first generation in nationwide Safety Performance Function (SPF) is integrated into the new Highway Safety Manual (HSM) and recent iterations of the Interactive Highway Safety Design Model (IHSDM) (Candia 2009, Dimaiuta 2009). The SPF is a family of crash rate prediction models designed to accommodate the largely rare and random nature of incidents (Hauer 2009 and 1997, Bahar 2009). It is a data intensive process that requires years of multiple 'peer site' crash data collection.

North Dakota initiated the systems approach with adopting as Strategic Highway Safety Plan in 2007 (North Dakota Department of Transportation 2007). The plan was developed by state agencies, with input from the public and local traffic safety stakeholders. The ND Department of Transportation took lead in developing the plan with an engineering perspective, and sought involvement from partners in the 4Es, including enforcement, education, and emergency medical services. The core strategies to reach goals in the plan are designed around these disciplines. The plan identifies nine emphasis areas for focusing roadway safety efforts: impaired driving, occupant protection, younger/older drivers, aggressive driving, lane departure, emergency medical capability, and intersections. Analysis will consider these emphasis areas in diagnostics and modeling of rural roads safety.

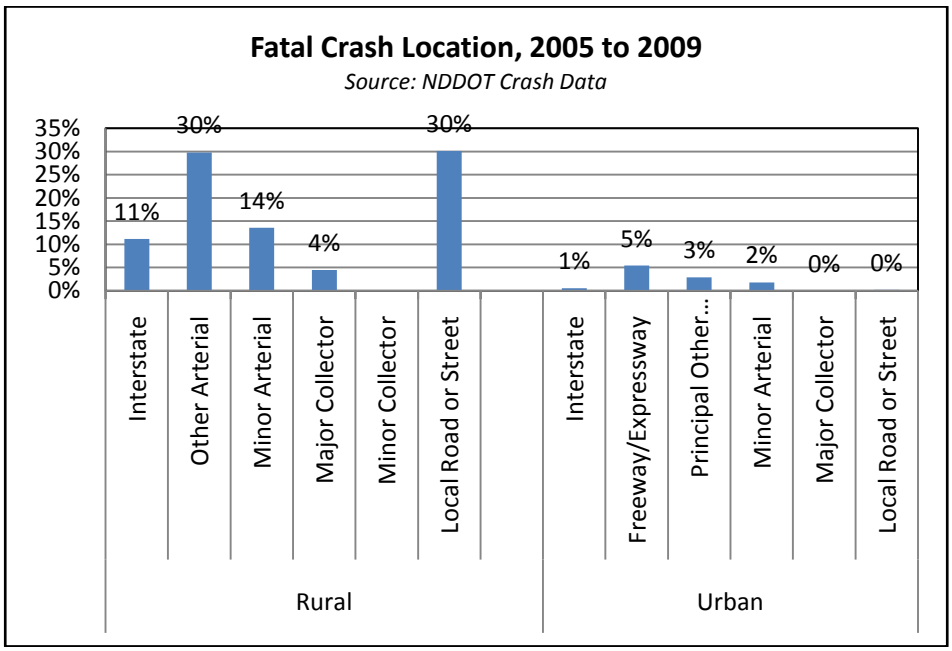

Figure 1. North Dakota Fatal Crash Location, by Functional Class

North Dakota consistently experiences a relatively high level of crash and serious injury on non-interstate rural roads considering the exposure aspect. Rural interstates are among the safest rural roads, considering exposure in annual vehicle miles traveled (Figure 1). Rural interstates account for about 18% of AVMT and 11% of fatal crashes between 2005 and 2009, for a crash incidence rate of 0.61 (FHWA 2009 and NDDOT 2010). This rate is less than the national rate of 0.80.

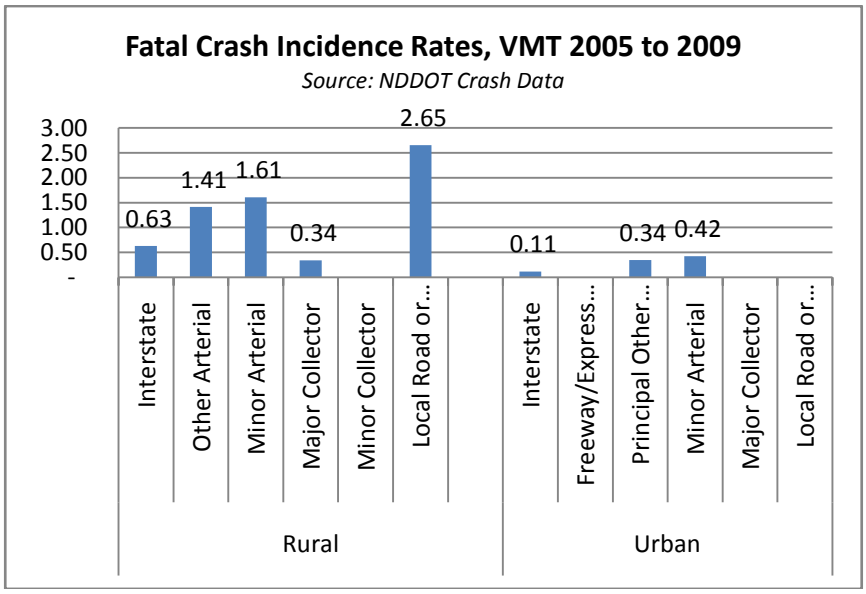

Figure 2. North Dakota Fatal Crash Incidence Rates, by Functional Class with Exposure in AMVT

Local rural roads in North Dakota have a risk level over four times higher than interstates, considering fatal crash incidence in AVMT exposure (Figure 2). Rural local roads are the location for 30% of fatal crashes, while these roads attribute only about 11% of AVMT, resulting in a fatal crash injury incidence rate of 2.65. It is also important to investigate property damage events as the likelihood to have it become more serious is more a matter of luck. If all roads had equal risk based on travel exposure, one would expect the incidence ratio to be equal to 1 for each of the functional road classes. Given that crashes are rather seen as somewhat random events in the rural road setting, it seems wise to investigate potential to enhance crash prevention knowledge for these roads through increased rigor in the decision-making process.

Research Objectives:

The goal of this project is to explore methods in diagnostics and modeling to provide decision makers with an improved and systematic understanding of local rural roads safety factors. State crash report and roadway attribute data for the most recent five years will be used to develop a prototype decision support system to identify priorities and select strategies most beneficial to local roads safety. It will be important to investigate the roadway environment at crash sites and to look for similar environments where there haven't been crashes yet, but there is a higher probability there could be. A final objective is to present the findings in a visual format to transfer the technology in layman's terms, especially to local agencies having limited safety engineering knowledge.

Research Approach / Methods:

Crash incident and site elements will be used to identify priority candidate site types and low-cost safety intervention. These may include engineering, education, and enforcement. The project will also be useful in producing metrics needed to satisfy internal and external program evaluation criteria for safety planning and programming related to rural roads safety.

The methods will include geoprocessing, statistical diagnostics, and multivariate regression modeling. The unit of study will be determined during the exploratory process. Possible units include roadway functional class, location type, site, county, and road segment. This research project will test several research applications and methods. An initial step in the analysis will be GIS geoprocessing to join crash and roadways elements. Additional GIS work will be done to create spatial elements needed to satisfy the peer group criteria for the study units. The systems diagnostic scan will be conducted as an initial filtering process.

Phase II would move the project into more detailed analysis and practitioner products. A prototype decision support system will be developed. Using the diagnostics and modeling, a process for safety project candidates, investment cost, and safety benefit will be demonstrated. It may include diagramming diagnostics and a case study with accident reduction factor analysis using alternative SPFs.

MPC Critical Issues Addressed by the Research:

1. High-Risk Rural Roads.
2. Effective Safety Management.
3. Human Factors.
4. Low-Cost Safety Improvements.

Contributions / Potential Applications of Research:

Pose diagnostic exercises and empirical modeling that may be used by other rural states seeking to address rural roads safety issues through strategic and systematic processes.

Potential Technology Transfer Benefits:

Research findings can be used to (1) discuss system design and implementation for systems approach to safety diagnostics on rural roads

and (2) further work for local development and calibration of national SPF functions for local and low-volume rural roads.

Time Duration:

July 1, 2010 – June 30, 2011

Total Project Cost:

$60,000

MPC Funds Requested:

$30,000

Source of Matching Funds:

NDDOT $30,000

TRB Keywords: Safety, Rural Transportation, Transportation Systems, Safe Travel, Public Services, Safe Driving

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