Background
- TOPS started May 2003
- Interagency Agreement (Similar to Master Contract)
- Co-Management Philosophy
  - WisDOT BHO
  - UW CEE Faculty
  - Mutually Beneficial Services and Research
  - Bi-Monthly Management Team Meetings

TOPS Laboratory Mission and Goals
Mission
“Improve traffic operations and safety in Wisconsin and across the Midwest through a diverse balance of service partnerships, research and training.”
Goals
- Leverage Synergetic Partnership of State DOT and University-based Transportation Research
- Fulfill the service-oriented needs of WisDOT while ensuring the core missions of the University are met
- Maximize use of UW-Madison Faculty and Facilities
- Leverage Other In-State University Resources, as appropriate
- Attract Talent to Wisconsin and Sustain Transportation Operations Related Workforce

Key Support Activities
- Meeting, Logistics, and Project Management Coordination
- Work Zone Management and Safety Advisory Group
- Tri-State Traffic Operations and Safety Summits
- Upper Midwest Traffic Operations Partners Coalition
- Traffic Safety Engineering Workgroup
- Statewide Traffic Operation Sketch Planning
- Staff Recruitment
- Training Coordination
- Private Industry Partnerships
- Administrative Support (Contracts, Invoices, etc.)

Laboratory Facility
- Hands-on experience for student and staff:
  - Traffic Signal Controllers
  - Traffic Data Collection Equipment
  - State of the Art Traffic Simulation Software
  - TOPS Project Staging and Bench Testing
  - Home of WisTransPortal

Representative Projects
12 Work Orders Complete, 22 In Progress
- WisTransPortal Transportation Operations Data Hub
- Road Weather Safety Audit Development
- Median Crossover Crash Analysis
- Volume Speed Occupancy (V-SPOC) Traffic Analysis Tool
- Intersection Safety and Run-off-the-Road Safety Countermeasure Initiatives
- 2004 National Highway Visibility Conference Support

Benefits to WisDOT
- WisDOT staff routinely uses tools developed by TOPS
- WisDOT gains expertise traditionally difficult to hire under civil servant process
- WisDOT has used UW facilities and services for meetings, training and other events
- Customer-oriented service based on high-quality, quick response services
- Significant academic discounts for software and hardware
- Extremely low overhead
- Allows WISDOT to leverage federal funding and private sector partnerships
- Other University/WisDOT relationships being modeled after TOPS
Development of Road (Weather) Safety Audit for Wisconsin

Introduction

- RSA is a formal examination of a future road or traffic project or an existing road, in which an independent, qualified team reports on the project’s crash potential and safety performance
- RWSA is the logical extension of conventional RSA with particular emphasis on highway safety from adverse weather impacts

Objectives

- To develop a comprehensive and formalized Road (Weather) Safety Audit program for Wisconsin
- Define and identify the key processes and procedures for Road Safety Audits (RSA) and Road Weather Safety Audits (RWSA) under the WisDOT organizational structure
- Provide a framework for the implementation of audit procedures through designed audit checklists covering various/all stages of a road project
- To integrate RSA/RWSA process with current WisDOT policy by incorporating it into the WisDOT Facilities Development Manual (FDM)
- To identify and provide sources/procedures for basic information regarding the preparation of data for various stages of the audit process

Organizational Structure for RSA/RWSA

RSA/RWSA Process and Procedure

1. Identify project to be audited
2. Select Audit Team
3. Pre-audit meeting to review project information and drawings
4. Perform field reviews under various conditions
5. Conduct audit analysis and prepare report of findings
6. Present audit findings to project owner/design team
7. Prepare formal response
8. Incorporate findings into the project when appropriate

RSA/RWSA Stages and Checklist

- Feasibility Stage Audit
- Preliminary Design Stage Audit (30% of design stage)
- Detailed Design Stage Audit (60% of design stage)
- Pre-opening Audit (Soon after project completion)
- Existing Road Audit

RSA/RWSA Integration into FDM

Audit Information Preparation

- Road Weather Information System (RWIS)
- National Weather Service (NWS) COOP Data
- Automated Weather Observing System (AWOS) Data

Crash Data Collection and Processing

- WisDOT Crash Database from MV 4000
- GIS Based Crash Data
- Spatial Analysis of Weather-Related Crashes on Macroscopic and Microscopic Levels

Recommendations

- Need interagency cooperation and collaboration
- Maintain the RSA/RWSA checklists as “Living Documents”
- Incorporate extra information from local resources
Demonstration of Automatic Mapping of Local Crash Location

Goal
Develop and test a location system that can map historical crash records for local roads

Method
Propose an algorithm for automatic mapping of both intersection crash and segment crash for local roads

Data Sources
- WisDOT crash database (MV4000)
  - Source (DMV extract)
  - Database (WisTransPortal)
- WisLR (Wisconsin I nformation System for Local Roads)
  - Source (BI TS)
  - Database (Oracle partial replication)
- Base map
- Local crash data
  - Madison
  - Dane County

Algorithm
Step 1: Filter crash records
  1.1: Remove parking lot and private property crashes
  1.2: Remove crashes with missing location information
    “on street=null” or “At street=null AND At highway =null”
Step 2: Parse the crash location into prefix, street name, type and suffix
Step 3: Find the WISLR route IDs
Step 4: Find the WISLR node by “on route ID” & “at route ID”
Step 5: Map the crash

Madison Crash Maps

Segment Crash Location Issues

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Next Steps & Recommendations
- Update WisLR information tables
  - Incomplete On_At ID Table & Street alternate names
- State Trunk Highways and Non-public Streets
- Maximize the crash location matching percentage
- Spelling Errors & Parsing Accuracy
- Match multiple records
  - Divided Highways & Horseshoe Streets
- Final Report
Work Zone Speed Management Strategies Evaluation

**Introduction**
Work zones present temporal roadway conditions that usually violate drivers’ expectations and therefore compromise the safety of construction workers and drivers. Speeding is one of the major contributors to work zone crashes. To reduce potential speeding-related crashes, WisDOT is seeking effective methods to manage speed at Wisconsin work zones.

**Objectives**
- Monitor and capture work zone speed characteristics.
- Measure the effectiveness of several work zone speed management strategies.
- Develop a non-intrusive, portable traffic data collection system and data collection plan.
- Build a Wisconsin work zone database to provide data-driven WZ impact assessment.

**Data Collection System**
Remote Traffic Microwave Sensor (RTMS)
- Volume, occupancy, and speed
- Long-term & continuous data collection
- No interference to the traffic

**Evaluation Results**
- Average speed on weekdays < Average speed on weekends
- Work Zone Activity Section
  - 85% + daytime drivers traveled above the posted speed limit
  - More nighttime drivers traveled over speed limit on weekends (67%) than on weekdays (46%)
- DLMS accommodated higher traffic demand in work zone

**Dynamic Late Merge System (DLMS)**
**Mechanism:**
Traffic detectors collect real-time traffic information and instruct drivers to make more efficient use of roadway by allowing them to use all available traffic lanes to the work zone merge point.

**Dynamic Speed Display Board (DSD)**
**Assumption:**
Drivers will reduce their speed if the display board shows their speeds exceed the posted speed limit

**Evaluation Site and Data Collection Locations**

**Evaluation Results**
- Most drivers slowed down in work zone
- DSD board did not significantly impact the speed in daytime hours
- DSD board significantly impacted the speed at night
- DSD effectiveness lapses over a long period of time

**Enforcement**
Three Enforcement Strategies
- Mobile enforcement
- Minimum stationary enforcement
- Intensive stationary enforcement

**Evaluation Site and Data Collection Locations**

**Evaluation Results**
- Speed on weekends is higher than weekdays
- Most drivers reduced speed in the zone
- Night reduction was less than day
- All enforcement strategies reduced the work zone speed
- Intensive stationary enforcement is the most effective at night
- Mobile enforcement is the most effective during the day

Source: Evaluation of 2004 Dynamic Late Merge System – for the Minnesota Department of Transportation
Work Zone Capacity Analysis Tool (WZCAT) Calibration/Validation Support

Background

- The Final Rule on Work Zone Safety and Mobility was published on September 9, 2004, requires all state and local governments that receive federal-aid funding to comply with the provisions no later than October 12, 2007.
- The rule requires development and implementation of procedures to assess and manage work zone impacts on individual projects.
- Work Zone Capacity Analysis Tool (WZCAT) is designed to assess the impact of short-term work.
- To conduct the validation and enhancement of WZCAT in an effective and efficient manner, comprehensive data collection was conducted based on experience from previous studies and available work zone related literatures.
- A total of eight data collection efforts were performed from July 2005 to November 2005.

Data Collection Summary

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The Current WZCAT is

- Step 1: Compares expected travel demand at the work zone location to the reduced traffic-carrying capacity. If demand exceeds capacity, the excess is assumed to store upstream of the work zone.
- Step 2: Input-output analysis is used to keep track of the amount of excess stored over time.
- Step 3: Vehicular delays and queue lengths are computed by using estimates of stored vehicles and approximate average vehicle lengths in the queue.

Findings

- Greatest lengths of queue developed within one hour of WZ start and stayed consistent throughout WZ duration.
- To reproduce the observed queue with WZCAT, travel demand should be similar to work zone capacity value which is embedded in WZCAT after initial queue development.
- Need to develop a procedure to prepare demand file for WZCAT with consideration of significant amount of natural diversion (less enter / more exit).

Traffic Demand/Flow Changes (WZ1)

Observations

- Observed Queue vs. Estimated Queue (WZ1)

Findings

- Greatest lengths of queue developed within one hour of WZ start and stayed consistent throughout WZ duration.
- To reproduce the observed queue with WZCAT, travel demand should be similar to work zone capacity value which is embedded in WZCAT after initial queue development.
- Need to develop a procedure to prepare demand file for WZCAT with consideration of significant amount of natural diversion (less enter / more exit).
Median Crossover Crashes (MCCs)
Magnitude and Severity Analysis

Background
- Of the 42,643 crash fatalities in 2003, over 25,000 were a result of vehicles leaving the travel lane
- 3,206 people were killed on Wisconsin's roadways, representing nearly 1.9 percent of the nation's total
- With the median widths of 60 feet or more, crashes involving vehicles traversing medians and entering the opposing traffic are increasing in frequency across the US. Wisconsin is believed to be no exception
- Until recently, the magnitude, characteristics, and causes of MCCs in Wisconsin were not widely investigated
- A detailed analysis of MCC magnitude and severity was necessary to improve safety on Wisconsin highways and facilitate the decision-making process regarding roadway safety enhancements

Data Collection
Time Span: 2001-2003
Domain: I-39, 43, 90, 94; USH 10, 12, 14, 18, 41, 51, 53, 141, 151; STH 23, 29, 30, 35, 54, 57, 172, 44

Findings
- MCCs are a significant problem for the state of Wisconsin
- MCCs and median width are not strongly correlated with each other
- Most MCCs involved either personal injury (53%) or a fatality (7%), only one vehicle (81%), vehicles moving straight on the roadway (77%). Younger drivers are more likely to be involved
- MCC costs exceed median barrier impact crashes by approximately $19 million annually
- Statistically, the safety belt use and horizontal curve absence decreased the odds of fatality vs. an injury or PDO. Crashed vehicles with stoppage on opposing lanes had a higher chance of more severe consequences than vehicles intruding partially or marginally.

Recommendations
- Consider median-based countermeasures at high crash location
- Traditional three-strand cable barrier
- High-tensioned cable barrier
- Additional median geometric data on locations studied to complete a full benefit/cost analysis
- Expand public awareness to the dangers of crossover median crashes

Data Reduction:
- All crashes involving lane-departures on median-divided roadways were identified as potential MCCs for possible inclusion. The associated WMVAR reports were obtained to review the narratives/ diagrams. Each report individually reviewed to confirm a MCC.
- Selected crashes were classified by location (county and roadway) and severity. Severity was grouped into three categories: Fatal, Injury, and Property Damage Only. Median widths and total ADTs on both directions for the crash sites were added to each crash report's data summary.
- 15,194 reports were obtained from WisDOT, and 732 crossover crashes were initially identified. 101 crashes were disqualified due to objects crossing over the median that median design would likely not have hindered. This re-exam reduced the total of crashes to 631.
- Before modeling, 16 crash records were deleted from the original data for missing information. Consequently, 615 MCC records were left for ensuing regression analysis.
**Wisconsin Statewide 511 Travel Info**

**Background**
- July 2000 – FCC designated 511 for Travel Info
- 28 services in 25 states deployed - available to 32% of population
- Nationwide, over 51 million calls to date
- Benefits of 511 Traveler Information
  - **Safety** – reduce crashes
  - **Mobility** – improve travel time and travel time reliability
  - **Productivity** – reduce early/late arrivals, saving lost time
  - **Efficiency** – better utilization of existing infrastructure
  - **Energy & Environment** – reduce fuel consumption and vehicle emissions
  - **Customer Satisfaction** – informed customers modify their departure times, routes, and travel modes
- Proposed FHWA Program Requires 511 Deployment by September 2009

**Current Wisconsin Status**
- Planning Study Completed
- Additional Due Diligence Completed
- Amber Alert Grant may support Amber Alert 511 feature
- Preliminary engineering and cost estimation underway

**Nationwide Deployment Status**

**511 Traveler Information Content**
Location Specific Voice and Data (Internet) Information

- **511 Telephone System**
  - Creating, Voice-Activated Menu Options
- **Access to Neighboring Systems**
  - MN, IA, MI, IL, GCM, RoadWIS
- **Highways**
  - Construction, Closures, Incidents, Congestion
- **Public Transportation**
  - Air, Rail, Bus, Ferry
- **Weather**
  - Route Conditions, Forecasts, Winter Road Conditions
- **Traveler Services**
  - Special Events, Roadside Services

**Logical Architecture**

**Next Steps**
- Continue preliminary engineering
- Continue work on data flows, management, storage, and integration
- Coordinate with telephone carriers and Public Service Commission
- Further refine initial 5-year start-up / O&M cost estimate
- Contingent on secured funding:
  - Develop RFP for Highway, Weather, and Alert Content
  - Proceed with RFP and commission Wisconsin 511

**Task**

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Source: 511 Deployment Coalition
Source: Wisconsin 511 Deployment Final Report
Source: Upper Midwest Traffic Ops Coalition

Wisconsin Statewide 511 Travel Info
WisTransPortal Project Overview

- The WisTransPortal is a statewide transportation operations and safety data management system that supports:
  - ITS Data Archiving
  - Data Integration and Analysis
  - Traffic Engineering Applications Development
  - Intra- and Interagency Data Sharing
- Project Website: http://transportal.cee.wisc.edu

WisTransPortal Project Timeline

- Phase I: June 2003
  - Business Plan and Technical Design
  - Database and Network Infrastructure
  - Web Application Platform Deployment
  - Preliminary Data Archiving and Applications
- Phase II: June 2006
  - Continued Build-Out of Fiber Network
  - Expanded Data Archiving Capabilities
  - Web-Based Data Export and Analysis Tools
  - Real-Time Data Exchange

WisTransPortal Application Framework

WisTransPortal Tools Development

- Crash Safety Analysis Toolbox
- ITS Data Clearinghouse Tools
- Data Extractor Enhancements (V-SPOC)
- Interagency Video Sharing (LINKS)
- Lane Closure Permitting System
- Detour Map Automation
- Support for 511 and Other Initiatives

WisTransPortal Detector Data Extractor

WisTransPortal System Interconnect

WisTransPortal Data Archive

- WisDOT MV4000 Crash Data (1994-2005)
- ATMS 5-Minute Detector Data (1996-Present)
- RWIS Environmental Weather Station Data
- Milwaukee Area Lane Closures / Incidents
- STN / WisLR Shape Files and Tables

WisTransPortal Network Environment

WisTransPortal Infrastructure

- Oracle 10g Database Enterprise Edition
- Direct Link to WisDOT Fiber Backbone (ITSNET)
- ESRI Arc MS / ArcSDE Spatial Data Servers
- Java Enterprise (J2EE) Web-Application Platform
- State-of-the-Art Servers, RAID Storage, and Network Infrastructure

WisTransPortal Project Website: http://transportal.cee.wisc.edu
Safety Analysis Tools

Safety Analysis Tools Overview

• TOPS Lab currently has complete archive of DMV Traffic Accident Section crash extract data for 1994-2005
• Database to support TOPS Lab research products and development of crash safety analysis tools as a component of the WisTransPortal system

Crash Data Export Facility

• Provide WisDOT BHO with Automated System to Streamline Crash Data Request Processing
• Current Status (Release 1.0 March 2006):
  • Online Crash Data Query / Export Tool for Internal WisDOT Use
  • External Data Request Submission Process Through WisTransPortal Website
• Future Development:
  • Advanced Query Functions
  • Access to Digitized Crash Reports
  • GIS Mapping Components
  • Integration with Other TOPS Lab Safety Tools
  • User Accounts

Intersection Safety Evaluation Tool (ISET)

• Provide WisDOT with Tool to Efficiently Use Existing Intersection Crash Data for Safety Analysis
• Compare Crash Rates and Percentages at One or More Intersections by Combinations of Intersection Characteristics and Geometric Features
• Complete Three Levels of Analysis - Minimum, General, or Specific

Crash Data Export Facility Highlights

• High Level Crash Data Query Interface
• Roadway / Intersection Query Refinement Tool
• Online Query Results Page (HTML Format)
• Data Download Tool (CSV Format)

ISET Highlights

• Seven Excel Worksheets for Data Input, Viewing Results, and Documentation
• User Selectable Safety Measure Thresholds
• Intersection Database from Intersection Crash Summary Statistics for Wisconsin Project (2001-2003)

Crash Data Export Facility - HTML View

Crash Data Export Facility - CSV View

ISET Input Sheet

ISET Results Sheet

www.topslab.wisc.edu