

**Project Title:**

Use of Travel Time, Travel Time Reliability, and Winter Condition Index Information for Improved Operation of Rural Interstates

**University:**

University of Wyoming

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**Research Needs:**

The Interstate 80 corridor between Cheyenne and Laramie experiences extreme weather conditions that result in a large number of crashes and frequent road closures. The Wyoming Department of Transportation has invested considerable resources in implementing Intelligent Transportation System Technology in this corridor to address safety concerns and the provision of traveler information is a major component of the ITS system.

Previous work has been done on improving the credibility, reliability, and quality of the traveler information provided by WYDOT but there is still a need to provide travelers with a better idea of the travel conditions they could encounter. Discussions with frequent traveler focus groups have identified a desire for a “rating system” for conditions. Currently many travelers delay travel only when a “No Unnecessary Travel” advisory is posted and view all other messages as representing minor hazards. Travel times and travel time reliability information have gained widespread use over the last five to ten years as a way of conveying congestion-related information to travelers in urban areas but has not been previously used in a rural setting to describe weather-related travel information.

However, on rural freeways, there is a greater diversity of user types, which require the study of additional travel time and reliability measures to ensure usefulness to all travelers. For instance, long-distance freight operators, out-of-state recreational travelers, and local residents all have substantially different needs regarding the form and location of travel information. Identifying one or more metrics, and methods of presenting new types of information in the most beneficial manner, will be the core tasks of this research.

The I-80 Corridor between Cheyenne and Laramie is an ideal corridor to research the applicability of applying these techniques to a rural setting since the corridor is already heavily instrumented and there is an advanced traveler information system in place. The research problem will address the applicability of travel time and travel time reliability measures from the

perspective of both passenger car and heavy vehicle travelers that are either frequent or first time users of the corridor.

WYDOT's Intelligent Transportation System Program currently utilizes extensive use of speed sensing equipment, most commonly non-invasive side fired radar equipment. This research will investigate the applicability of using speed sensor equipment as well as vehicle monitoring devices such as blue tooth or wi-fi signal readers to calculate corridor travel times. Bluetooth and wi-fi signal (sometimes referred to as differential RF) readers sense devices in vehicles that emit Bluetooth or wi-fi communication signals and read the unique Media Access Controller (MAC) address that these devices have to match up vehicle observations at different points along the roadway. While these MAC addresses are unique to the device they do not contain identification information to the specific vehicle or driver so they are not considered invasive to personal privacy. Travel times will be estimated using each of these device types as well as a combination of both to determine the technology that provides the best travel time estimates.

There is likely a cost advantage of using Bluetooth or wi-fi reader technology over speed sensor technology for the calculation of travel times as well as a potential for more accurate travel time calculations. A travel time estimation algorithm for both the interstate and highway corridors will be developed using one or both technologies, depending on the results of the field tests for both technology types. An alternative technology that could be considered in place of the Bluetooth reader would be automated license plate readers but this technology is viewed by many to be to invasive of privacy.

### **Research Objectives:**

The objective of this research work is to investigate the applicability of traveler information on travel time and travel time reliability measures to a rural interstate corridor for use in making travel decisions by passenger car and heavy vehicle travelers. One or more metrics will be identified, considering usefulness to different traveler classes, including commercial and private trip purposes, and differing familiarity with local freeway and weather conditions. The use of a travel or winter condition index based on travel times will also be investigated to see if this is more intuitive metric to rural drivers.

### **Research Methods:**

The methodology for meeting the research objective stated above is broken down in to the following tasks:

1. Develop travel time and travel time reliability calculation methodologies for our corridor based on the existing technology in the corridor, explicitly considering the concerns and needs of both passenger cars and heavy vehicles, experienced and unfamiliar users, and local and regional trips.
2. Use data from the corridor over the previous two winters to run a "simulation" of travel times to determine the sensitivity of the calculations to different weather events and to set guidelines for reporting thresholds to the different traveler information sources.

3. Use corridor data over the previous two years to calculate travel time reliability measures.
4. Relate corridor travel times and travel time reliabilities results to weather forecasts for the same time period to determine the feasibility of forecasting travel times based.
5. Work with focus groups from different stakeholder sectors to determine the general understanding and acceptance of travel time and travel time reliability measures.
6. Identify methods for conveying these measures to travelers, considering the advantages and disadvantages of using current or new information provision channels.

**Expected Outcomes:**

The expected outcomes in an operational protocol for the Wyoming Department of Transportation's Traffic Management Center for implementation of travel time based traveler information. The results will also be disseminated to a broader audience through technical papers and presentations. The developed algorithms for travel time calculations will be packaged into a prototype software for use by other agencies.

**Relevance to Strategic Goals:**

The primary focus area for this research is Safety. The research also addresses the issue of Economic Competitiveness due to the heavy reliance of the project corridor by freight travelers.

**Educational Benefits:**

Graduate and undergraduate researchers will be involved with project. The suitability for the research results to be turned into a teaching case study for the USDOT's ITS Professional Capacity Building Program will be considered. The need for ITS case studies was identified as a need in an ITS PCB University Workshop in January of 2011.

**Work Plan:**

The project consists of the following major tasks over a 12 month period. The expected duration of each task is in brackets at the end of each task.

1. Develop travel time and travel time reliability calculation methodologies [2 months]
2. Run simulation of travel times on data from two previous winters to determine the sensitivity of the calculations to different weather events and to set guidelines for reporting thresholds. [3 months]
3. Use corridor data over the previous two years to calculate travel time reliability measures. [3 months – concurrent with task 2]
4. Relate corridor travel times and travel time reliabilities results to weather forecasts for the same time period to determine the feasibility of forecasting travel times based [ 2 months].
5. Work with focus groups from different stakeholder sectors to determine the general understanding and acceptance of travel time and travel time reliability measures [3 months].

6. Identify methods for conveying these measures to travelers, considering the advantages and disadvantages of using current or new information provision channels [ 3 months – concurrent with task 5].
7. Complete draft report for review [1 month]
8. Prepare draft technical papers [1 month – concurrent with task 7]
9. Finalize report and submit technical papers for publication and presentation [1 month]

Total project duration: 12 months (Jan. 1, 2011 – Dec. 31, 2011)

**Project Cost:**

Total Project Costs: \$180,772

MPC Funds Requested: \$79,442

Matching Funds: \$ 101,330

Transportation (secured Aug. 2011)

Source of Matching Funds: Wyoming Department of

**TRB Keywords:** Travel time, reliability, advanced traveler information systems, rural transportation, weather

**References:**

- Bates, J. (2001) The Valuation of Reliability for Personal Travel. *Transportation Research Part E*, Vol 37, pg 191-229
- Bertini, R. and D.J. Lovell. (2009) "Impacts of Sensor Spacing on Accurate Freeway Travel Time Estimation for Traveler Information" *Journal of Intelligent Transportation Systems*, Vol. 13 (2), pgs 97-110.
- Bogers, E.A., H.W.C. Van Lint, and H.J. Van Zuylen. (2008) Reliability of Travel Time Effective Measures from a Behavior Point of View. *Transportation Research Record 2082*, pgs 27-34.
- Ettema, D. and H. Timmermans. (2006) "Costs of Travel Time Uncertainty and Benefits of Travel Time Information: Conceptual Model and Numerical Examples" *Transportation Research Part C*, Vol 14(5), pgs 335-350.
- Monsere, C. et al. (2009) *Developing Corridor-Level Truck Travel Time Estimates and Other Freight Performance Measures from Archived ITS Data*. Oregon Department of Transportation FHWA-OR-RD-10-07
- Rafferty, P. (2009) Practical Benefits Analysis of Travel Time Reliability from Automated Detection. *Transportation Research Record 2115*, pgs 119-126.
- Turner, S., R. Margiotta, and T. Lomax. (2007) *Lessons Learned: Monitoring Highway Congestion and Reliability Using Archived traffic Detector Data*. Federal Highway Administration. FHWA-OP-05-003.
- Margiotta, R. (2005) Congestion and Reliability: Agency and User Perspectives. Proceedings from the 84<sup>th</sup> Annual Meeting of the Transportation Research Board.
- Small, K., C. Winston, and J. Yan (2005) "Uncovering the Distribution of Motorists' Preferences for Travel Time and Reliability" *Econometrica*, Vol. 73(4) pgs 1367-1382.
- Zou, N., J. Wang, G. Chang, and J. Paracha. (2009) "Application of Advanced Traffic Information Systems Field Test of a Travel-Time Prediction System with Widely Spaced Detectors. *Transportation Research Record 2129*, pgs 62-72.