Rural Travel Times

WYDOT Sponsor:

R. Vince Garcia, P.E., ITS Program

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Introduction

Wyoming experiences extreme weather conditions throughout the state that result in a large number of crashes and frequent road closures. The Wyoming Department of Transportation has invested resources in implementing Intelligent Transportation System Technology throughout the state to address safety concerns and the provision of traveler information is a major component of the ITS system. The WYDOT travel information web page, telephone and text messaging services, and roadside traveler sources such as dynamic message signs are providing travelers with real-time information to help address the safety risks that travelers may encounter. Even with these information sources travelers may still be faced with uncertainly about travel decisions, a particular challenge is determining the severity of the roadway conditions they are likely to face. Two questions regarding travel decisions during inclement weather that travelers are often trying to answer are how severe is the particular condition and what is the extent of the condition (i.e. what portion of the trip is subject to these conditions).

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 (Ringenberg & Young, 2010). 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. While travel time information has been deemed successful in urban conditions it 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. Commute traffic has a baseline for the trip time to compare the real-time travel information against. As the traffic mix becomes comprised of more infrequent travelers the usefulness of travel time becomes less certain. For Wyoming it is likely that a mix of both real-time travel times and a rating system (i.e. 1 to 10, or green, yellow, red, black) will be necessary to convey the conditions to a wide variety of road users.

The I-80 Corridor between Cheyenne and Laramie is an ideal corridor as a starting point 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.

But travel in inclement weather in Wyoming is certainly not limited to the state's interstate corridors. Travel on the rural highways also poses a safety risk during weather events and travelers on these roadways are also trying to determine the extent and the severity of the weather conditions. Travel time information on these types of roadways may also prove valuable although the challenges of estimating travel times is different than methods on interstates given the higher number of access points and roadside stops.

Preliminary conversations with Shelby Carlson, WYDOT District 5 Engineer have identified Wyoming Highway 28 over South Pass as a candidate non-interstate route to for this research project. The South Pass highway encounters frequent severe weather conditions that would make travel time information valuable to travelers. Recent increases in oil and gas field development in that part of the state have led to increased travel on this route. There are plans to add permanent dynamic message signs on the route that could be used for the testing of travel time or condition severity rating information developed by this research.

WYDOT's Intelligent Transportation System 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 readers to calculate corridor travel times. Bluetooth readers sense devices in vehicles that use Bluetooth communications 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. A travel time estimation algorithm for both the interstate and highway corridors will be developed. 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.

The travel time information can be conveyed to users in both pre-trip and during-trip form through a combination of existing information sources such as the WYDOT website, phone and text messages

service, and roadside dynamic message signs. Pre-trip sources are particularly useful for travelers making the go/no-go decision. Roadside sources can be used at critical turn around points and also to help drivers making decisions about speeds and the use of cruise control.

A critical part of the research will be the determination of how different traveler groups are interpreting and using the travel time information including frequent travelers, infrequent and first time travelers, tourists, and freight vehicle users. This information will be obtained from focus groups and travel surveys. The question of the usefulness of larger scale deployment of travel time information will also be addressed during this process. The users' perspectives on the most useful sources of the information will also be surveyed.

Background

A number of Departments of Transportation in the U.S. are investing in the field of traveler information because having an informed public results in better public decision making. Some of the states which have invested in this field are Florida, Washington, Minnesota, Colorado and Indiana (Martchouk & Mannering, 2009). The more informed a driver is about what they are driving into, the more that the problems of accidents, driver frustration and traffic congestion will be alleviated. In particular, providing information on travel time and travel time reliability is something that DOT's in several states (including Colorado, Indiana and Washington) are investing in because they have proven to be effective ways of helping people to drive safely; reducing driver frustration and helping people choose routes which avoid congestion. Travel time is shown as an estimate of how long it will take a traveler to arrive at a particular destination from their current location. Concurrently, travel time reliability is usually measured as a reasonable upper bound of time that someone could expect to travel, usually based on the 85^{th} or 90^{th} percentile of travel time (Federal Highway Administration, 2006).

The following are just a few examples of how DOT's from across the country have started to implement a system of travel time measurements to reduce congestion and alleviate driver stress:

The Washington Department of Transportation provides a service where people can find a worst case scenario of the amount of time that it will take someone to travel to a given starting and ending location. This is accomplished through a tracking system, where volunteer probe vehicle commuters have their travel times recorded. Travel time reliability measures are calculated for each link as the 95^{th} percentile travel time. Once a user chooses inputs starting and ending locations from a given list of locations along the Seattle area (along with a departure time), the service program on the WSDOT website estimates travel time and a $95^{\%}$ reliable travel time. In addition, the option to modify the route is given to the user,

and a new 95% reliable travel time estimate is automatically calculated. Key points along the route (ie from origin to highway intersections) are also calculated to give the user an idea of whether they are ahead of or close to the 95% reliable travel time as they are driving (Federal Highway Administration, 2006). WSDOT also make reliability measures for freeways and high-occupancy vehicle (HOV) lanes. WSDOT uses the 90th percentile travel time with congestion performance measures to determine what the optimal route is. The web page on which these travel time estimates can be located are on: http://www.wsdot.wa.gov/traffic/seattle/traveltimes/commutes/ An example graphic showing what the information shown from by the website is shown in Figure 1~~Figure 1~~.

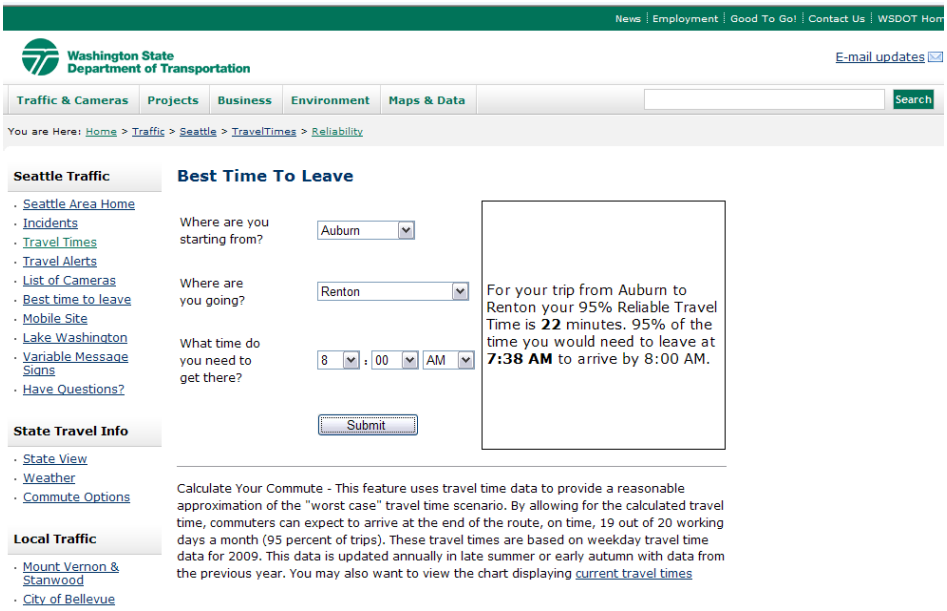


Figure 1: WSDOT Travel Time Reliability Display

In Colorado, travelers can view estimated average travel times along the I-70 corridor on overhead DMS's between the cities of Keystone and Denver, with each sign giving information on how long it will take to reach intermediate locations. This information has proven especially effective at reducing driver frustration during the ski season, where congestion can stretch for literally tens of miles. Although there are few if any alternative routes along this corridor (including the ski towns of Vail, Copper Mountain and Loveland), people benefit from knowing whether or not they can expect congestion for the entire trip back to Denver (Smith, 2010). An example of the travel information display is shown in Figure 2.

Figure 2: Travel Time Sign on I-70 in Colorado

The Colorado system is closest to the application proposed in this research but differs in several key ways. The first is that variability in the travel times is mainly due to congestion along the corridor from to heavy ski traffic. The corridor is through mountainous areas that are subject to inclement weather conditions but the heavy volumes along the corridor cause the majority of delays. Travelers using the travel time information are typically trying to determine the level of congestion at a particular time as opposed to trying to gauge the severity of weather conditions. The other significant difference between the I-70 corridor and the proposed Wyoming corridors is the use of technology. The main technology component of the I-70 travel time estimation is transponder readers that read toll transponder information from vehicles at different points along the corridor. Even though the corridor is not currently tolled there are toll roads in the Denver area so the percentage of travelers on I-70 with a transponder is high enough to use for travel time calculations.

Study Benefits

This project will determine the applicability of using traditional urban travel time and reliability measures in a rural setting. If found to be applicable, improved and more useful roadway condition information can be provided to local and regional travelers, providing immediate benefits in safety, information credibility, and freight reliability. The results will be applicable to other corridors in Wyoming and in rural interstate corridors throughout the country.

The research will develop a travel time calculation algorithm and a recommendation on the types of technology best suited for Wyoming corridors.

Work Plan

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.

Project Tasks

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

Phase 1:

1. Develop travel time and travel time reliability calculation methodologies for the Interstate 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 I-80 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. Install technology for the highway corridor and develop a travel time and travel time reliability methodologies.
4. Use data from the I-80 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.
5. Use corridor data over the previous two years to calculate travel time reliability measures.
6. 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.

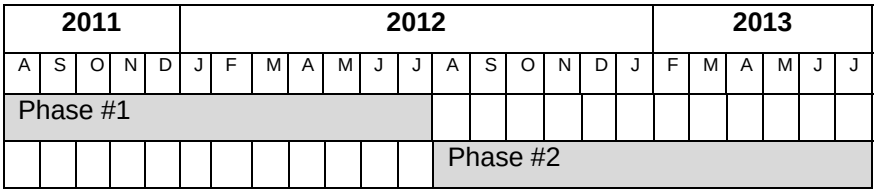
Phase 2:

7. Continue to work to refine the methodologies developed in Phase I.

8. Work with focus groups from different stakeholder sectors to determine the general understanding and acceptance of travel time and travel time reliability measures.
9. Identify methods for conveying these measures to travelers, considering the advantages and disadvantages of using current or new information provision channels.

Work Schedule

Overall, the project is scheduled to last 24 months, beginning in August of 2011 and ending in July of 2013. The first phase focusing on the installation of technology and the travel time estimation algorithm development is expected to take 12 months. The second phase focusing on the use and understanding of the travel time information is expected to take an additional 12 months. Estimated start and end times of each of the phases are shown below.



Cost Estimate

The total cost estimate for the research tasks outline in the previous section is **$130,730**, which includes support of a graduate student for two years. The cost estimate also includes $41,000 in road monitoring equipment. A detailed breakdown of the proposed costs is included at the end of this proposal.

Technology Transfer

Technology transfer will be accomplished through interaction and close communication with the Wyoming Department of Transportation and other stakeholders throughout the research process. Research results will be disseminated through a final report, one or more technical papers in peer-reviewed journals, and technical presentations at national conferences, such as the annual meeting of the Transportation Research Board.

The recommendations on technology to use to estimate travel times and the travel time estimation algorithm are both transferable to other rural corridors.

References

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PROJECT TITLE: Rural Travel Time Estimation		
UNIVERSITY: University of Wyoming		
P.I.: R. Young	**BUDGET PERIOD:** August 1, 2011 - August. 1, 2013	
Research Agency:	Department of Civil and Architectural Engineering	
	1000 E. University Avenue, Dept. 3295	
	Laramie, Wyoming 82071	
Contract Period:	24 Months	Funds Requested
A. Senior Personnel		
1. Rhonda Young	(1.5 months of support)	13,700
	(A) Total Senior Personnel	**13,700**
B. Other Personnel		
1. One(1) Graduate Student	(24 Months)	30,900
2. Student Assistant	($8.50/hr x 470 Hrs)	4,000
	(B) Total OPS	**47,300**
C. Fringe Benefits		
1. Senior Personnel x 45.56%		6,242
	(C) Total Fringe Benefits	**22,147**
D. Operating Expenses		
1. Computer Usage & Service		1,200
2. Communication		300
3. Office Supplies		200
	(D) Total Operating Expenses	**1,700**
E. Technology Transfer		
1. Presentation of Findings in Meetings,		2,500
Conferences and Workshops		
2. Travel to Project Sites		1,500
	(F) Total Technology Transfer	**4,000**
F. Equipment		
1. Speed Sensors	3 Locations	15,000
2. Bluetooth Reader	3 Locations	21,000
3. Power & Communications		5,000
	(I) Total Equipment	**46,600**
G. Total Direct Costs (A Through F)		**101,542**
H. Indirect Costs (Specify Rate & Base)		
1. Indirect Costs	20% for State Funds	20,308
	(G) Total Indirect Costs	**130,730**
I. Tuition and Fees		
1. Tuition and Fees	No indirect cost on tuition	12,800
	(H) Total Tuition	**12,800**
J. Total Direct and Indirect Costs (G+H+I)		**130,730**