

TRANSPORTATION RESEARCH DIGEST

DECEMBER 2008

ARIZONA TRANSPORTATION INSTITUTE

e-mail jsemmens@cox.net

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TO: TRANSPORTATION PROFESSIONALS, MANAGERS, & POLICY MAKERS

FROM: ARIZONA TRANSPORTATION INSTITUTE

The volume of information on transportation issues, policies, technologies, and related topics is huge. Not even the most well-read professional can keep up with everything that might be useful to know. The *Transportation Research Digest* series is designed to expedite the transmission of information by condensing and summarizing significant documents. Busy professionals or managers may quickly obtain the gist of new developments and determine whether they need to see the full document.

The *Transportation Research Digest* is not meant to present definitive resolutions of scientific or policy controversies, but contributions to the pursuit of knowledge and the debate of issues. The intent is to be comprehensive rather than conclusive on the multitude of issues and topics of concern to those working in the field of transportation. Readers are encouraged to obtain the original document summarized in the *Transportation Research Digest* and subject the content to their own judgment.

Transportation professionals who would like to recommend documents to be summarized or submit summaries to be considered for inclusion in this publication are invited to do so. To recommend a document please send a copy (or information indicating how a copy can be obtained) of the research report to be summarized. To be considered, the report must meet the following requirements: (1) it is transportation related, (2) it is no more than two years old, (3) there is enough information in the report to warrant a two page summary. To write a summary, insure that the document being summarized meets the above requirements. The summary should be submitted in an electronic format. This summary should be in the 500 to 800 word range and may include tables and/or simple graphics—all of which must fit within the *Transportation Research Digest's* two-page format. Submissions are subject to editing for clarity and length. We do not guarantee that all submissions will be published.

If you would like to obtain the full report upon which a *Transportation Research Digest* summary is based you have several options. Check your local university library. You may want to contact the publisher using the contact information appearing in the *Transportation Research Digest*. Some of the documents are free for the asking. Others can be purchased.

There is a database listing of all the previously published *Transportation Research Digests* that we have on file (back to 1984). Copies of the list or of portions of the list selected by topic or mode can be provided on request. You may also access the database via the internet at

Transportation Research Digests from December 1995 to November 2003 are available on request.

A “Topic” code in the Table of Contents will help readers more quickly identify items of interest. The topic codes are explained in the table below.

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AVIA	Aviation	RAIL	Railroads
BIKE	Bicycles	RDSO	Roadside
CON	Construction	ROW	Right-of-Way
ECON	Economics	SAFE	Safety
ENV	Environment	STR	Structures
FIN	Finance	TECH	Technology
INOV	Innovations	TOLL	Toll Roads
MAIN	Maintenance	TRAN	Transit
MISC	Miscellaneous	TRF	Traffic
MVD	Motor Vehicle Dept	TRK	Trucking
PAVE	Pavement	VEH	Vehicles

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Thank you.

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General Aviation Safety and Security Practices, ACRP Synthesis 3 by Craig Williams, RS&H Naperville, Illinois (Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001; (202) 334-3213; <http://gulliver.trb.org/bookstore>) (2007)

Highlights

- ❑ The objective of this synthesis report is to identify current practices in safety management and security operations at general aviation airports.
- ❑ Over the past 40 years, safety in the general aviation arena has greatly improved.
- ❑ 97% of the nearly 20,000 airports in the U.S. are general aviation airports.

Over the past 40 years, safety in the general aviation arena has greatly improved. The reasons are many and include improved aircraft reliability, pilot training enhancements, and better weather reporting capabilities. One often overlooked contributor to this safety record is the contribution made on the ground by general aviation airport operators, as well as those fixed base operators (FBOs) who service general aviation aircraft. In addition, often included as an aspect of aviation safety but different in both its planning and response, is airport security. Since 2001, airport security has been the primary concern within the airport community. Although significant regulatory focus is justifiably placed on protecting commercial aviation airport facilities, these facilities are but one small element of the entire nationwide airport system. Those airports serving commercial aviation number fewer than 600, or approximately 3% of the 19,800 total landing facilities throughout the country.

The objective of this synthesis report is to identify current practices in safety management and security operations at general aviation airports and FBOs. Through the use of

a survey of individual airports and FBOs, this report identified current practices and highlights unique, low-cost ideas that may be in use at one airport, but transferable to others. From a total of 60 surveys distributed, 53 responses were received for a response rate of 88%. Additional information for this synthesis report was collected during a literature search, and from documents made available by selected airports, FBOs, and industry trade associations. Also, the survey identified resources used to develop safety and security materials at general aviation airports. Additional information, taken from the author's personal experiences, follow-up interviews with survey respondents, and other industry contacts are, where appropriate, shared in the report.

It was found that federal regulation of general aviation airports is limited and often deferred to the states. More than half of the states have licensing and inspection requirements for general aviation airports. These requirements often mirror those imposed on commercial service airports under Title 14, Code of Federal Regulations (CFR), Part 139, which most of the survey respondents use as a basis for establishing safety plans at their airports. Airports understand and appreciate the importance of safety planning and often extend this to emergency response and wildlife control. Training is taken seriously at general aviation airports, and both airports and FBOs use initial and recurrent training to ensure the safety of the ramp environment. The FBO community is advancing this effort by

developing computer-based training and best management practices for common operations on the ramp.

It is only within the past five years that airport security has come to mean more to general aviation than ensuring that the aircraft is secured to prevent theft. Resources developed by a number of federal, state, and local government agencies and industry organizations are available to the general aviation airport community, and many airports are taking advantage of these resources to implement a more structured security program

at their facility. Airport security is also not limited to airports. FBOs, corporate business aircraft users, and other tenants are realizing the importance of securing the entire general aviation system. Airports are also expanding the universe of organizations available to help them secure the airport, and frequently enter into agreements with the local emergency response community, federal and state law enforcement agencies, or other entities that can participate in an airport operator security program.

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Best Practices to Enhance the Transportation-Land Use Connection in the Rural United States, NCHRP Report 582 by Hannah Twaddell & Dan Emerine (Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001; (202) 334-3213; <http://gulliver.trb.org/bookstore>) (2007)

Highlights

- The number one challenge for rural communities is to provide access within the community to destinations such as jobs, shops, services, education, and healthcare.

Significant research and implementation in recent years has helped to identify best practices for integrating land use and transportation in urban areas, but little has addressed how this integration could apply to rural communities. To fill this gap, the Transportation Research Board of the National Academies has funded *Best Practices to Enhance the Transportation-Land Use Connection in Rural America* (NCHRP Project 08-52), a study highlighting transportation investments and programs that support successful community development and land use strategies that maximize transportation capacity and community livability. In addition, the project examines how the goals of rural communities and transportation agencies may conflict or support one another.

Three core rural community types with distinct transportation and land use issues are identified in this report as particular focal points for the research:

Exurban communities, which exist on the fringe of most urban areas across the United States. Many of these communities have shifted from a traditional reliance on a local economic base to a level of dependence on jobs outside of the community and are growing at an above-average rate of 5% per year.

Destination communities, situated in locations featuring natural amenities such as mountains, lakes, or beaches attract seasonal residents, retirees, and tourists. Located primarily in the West, Upper Great Lakes, and New England, the economic base in these communities has shifted from traditional rural industries (e.g., agriculture, manufacturing, or mining) to a service-based economy built around providing access to natural amenities and support of a recreational or leisure culture. These communities are growing at an above average rate of 6% per year.

Production communities, which are typically found in remote areas such as the Great Plains, Corn Belt, Mississippi Delta, and Appalachia. These communities depend on a single industry that has experienced decline, such as agriculture, manufacturing, or mining. These communities have not diversified their job base and are isolated to the extent that they cannot depend on surrounding job centers, leading to a below-average growth rate of 2% per year and a loss of jobs.

Rural communities face a number of challenges. Surveys for this project indicated that the number one challenge for rural communities is to provide access within the community to destinations such as jobs, shops, services, education, and healthcare. The particular type of accessibility need for each community varies based on the community's particular setting and economic base. For example, exurban communities are primarily concerned with providing access to jobs in adjacent urban centers; destination

communities focus on bringing visitors into the community and providing access to tourist destinations; and production communities either attempt to improve accessibility between local products and their markets or to diversify the local economy. Other frequently cited challenges include maintaining or improving water and air quality, improving driver safety, protecting open space and environmentally sensitive lands, and providing access between the community and destinations around the larger region.

Each type of rural community can benefit from addressing these challenges through integrated approaches that simultaneously improve their accessibility and their livability. Best practices and strategies for achieving these results within various types of communities fall into three major activities:

1. Set the regional framework for where and how development should occur, through

- Growth management and preservation strategies to guide development into suitable locations and
- Regional access management strategies promoting access to designated development areas as well as discouraging unwanted rural development.

2. Improve local accessibility to daily needs such as jobs, shopping, services, and health care, through

- Development standards and plans to promote mixed-use, walkable community centers; and
- Transportation investments focused on improving street connectivity, pedestrian and bicycle facilities, and transit service to community focal points.

3. Enhance community design, through

- Context-sensitive roadway design techniques that complement natural and built environments; and
- Local access management and community design strategies, particularly along key commercial corridors.

Major venues for integrated planning

- Regional plans;
- Corridor plans;
- DOT rural consultation programs; and
- Local comprehensive and master plans (counties, cities, and towns).

Key factors for success

- Collaborative partnerships;
- Focusing on quality of life and sustainability;
- Public involvement and education; and
- Strong local leadership.

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Driveway Regulation Practices, NCHRP Synthesis 304 by Kristine M. Williams, Center for Urban Transportation Research, University of South Florida (Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001; (202) 334-3213; <http://gulliver.trb.org/bookstore>) (2007)

Highlights

- Driveway regulation practices vary widely from state to state.
- The more contemporary driveway regulation programs are oriented toward comprehensive and system-wide access management of state highways.
- Political interference and a lack of understanding by affected businesses are current problems in their driveway permitting programs.

Driveway regulation practices vary widely from state to state. In addition, the scope of driveway regulation programs can vary from comprehensive access management to basic design objectives. Although the objectives of agency driveway regulation programs vary in scope, they are generally oriented toward assuring a safe and efficient transportation system, while providing reasonable access to private property. Many agencies also seek to accomplish administrative objectives, such as uniformity of procedures and standards, consistency in decision making, efficient turnaround for issuing permits, intergovernmental coordination, and adequate training of permit staff.

At a minimum, state driveway regulation programs provide state oversight of construction within the right-of-way of a state highway and address issues such as drainage, installation of culverts, driveway location/sight distance, driveway design, and driveway construction. Applicants must obtain a permit, often called a right-of-way encroachment

permit, for these activities. However, state transportation agency practices vary considerably in the extent of access control or impact mitigation activities.

Some of the state transportation agencies responding to the survey of current practice have recently updated and expanded their driveway regulation programs. Several of these agencies indicated the need to expand their existing regulatory powers and statutory authority to ensure safe and efficient access. These contemporary programs provide insight into the state of the practice in driveway regulation and permitting.

In general, the more contemporary driveway regulation programs are oriented toward comprehensive and system-wide access management of state highways. The programs are designed to systematically regulate all highway access locations, including driveway access, as well as street connections, median openings, signals, turn lanes, and interchanges.

Of the adverse impacts identified, the most frequently noted address development considerations. Almost one-third of state respondents and approximately two-thirds of local respondents reported that their driveway permitting programs yielded "development constraints." A similar number of state and local respondents noted "increased development costs" as an adverse impact.

Politics is a significant factor in driveway regulation. One-half of the state transportation agencies indicated that political interference and a lack of understanding by affected businesses are current problems in

their driveway permitting programs. Approximately one-third of the state respondents are also experiencing problems with inconsistent decisions and inadequate intergovernmental coordination with local agencies.

Adding to political constraints is the difficulty of implementing and enforcing driveway regulations given limited staff and resources. State transportation agencies, in particular, reported insufficient trained staff and inadequate agency resource~ for permitting, inspection, and enforcement. Related problems included inadequate fees to help cover administrative costs and the additional time needed to handle complex applications. Some states are responding to this challenge by transferring inspection or permitting functions to local agencies or the private sector. However, as one respondent noted, private sector oversight of inspection functions can lead to conflicts of interest.

Another set of problems relates to inadequate statutory authority or outdated standards. A key regulatory weakness noted by several state and local agencies concerns the inability to require developer mitigation and offsite improvements. Other regulatory weaknesses include the lack of authority to deny access or require alternative access under

certain conditions and the lack of adequate enforcement penalties for noncompliance.

Although most state and local agencies can deny access under certain conditions, these conditions tend to be narrow in focus, with a clear safety hazard or regulatory violation being the most typical conditions for access denial. However, 12 states responding to the survey stated that they could also deny direct highway access where reasonable alternative access is available.

The review of current practice suggests that driveway regulation is in transition. State transportation agencies are expanding the scope of right-of-way encroachment permitting to address a broader range of access and development issues. Local governments are similarly expanding their 'driveway regulation policies. These contemporary driveway permitting programs delve into the more complex and comprehensive objectives of access management and mitigation by developers. To facilitate the transition, practitioners noted the need for national access management guidelines from professional transportation organizations, as well as better education of politicians, developers, and the public about the importance and value of access management.

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e-mail jsemmens@cox.net

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Estimating Nonmotorized Travel Demand by Meiwu An and Mei Chen in *Transportation Research Record 2002* (Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001; (202) 334-3213; <http://gulliver.trb.org/bookstore>) (2007)

Highlights

- The employment density in a neighborhood appears to be the most significant factor.
- The methodology of forecasting nonmotorized travel mode share can be extended to estimate total nonmotorized trips if data are available.

In this paper, the factors influencing nonmotorized mode share were analyzed. The factors are categorized into socioeconomic, environmental, and nonmotorized travel facility groups, which are generated and developed with data from multiple sources, including the 2000 census, the 2001 *National Household Travel Survey*, employment data, and sidewalk inventory data. The concept of neighborhood is introduced to provide a more accurate representation of the characteristics of an area within the range of a nonmotorized trip. Analysis of the correlation between these factors was performed, and the mode share was analyzed at a finer spatial scale, which facilitates the potential integration of the nonmotorized travel model into the traditional travel demand model. A regression model was developed with the set of the most powerful independent variables representing all three categories mentioned above.

The strong correlation between mode share and socioeconomic variables is congruous with the conclusions of existing studies. Environmental variables (especially neighborhood land use patterns) significantly affect nonmotorized travel mode choice, and this result has generally not been seen in

existing research. A strong relationship between mode share and nonmotorized facility-related factors also exists. The strong correlation among environmental variables, nonmotorized facility-related factors, and mode share implies that it might be important to collect relevant data such as employment and the nonmotorized facility inventory to estimate nonmotorized travel demand. The employment density in a neighborhood appears to be the most significant factor. This may imply a strong connection between the land use pattern and people's nonmotorized travel decision.

A multiple linear regression technique was used to examine the major factors with explanatory and predictive powers given all the socioeconomic, environmental, and facility-related variables. The model used to estimate nonmotorized travel mode share was developed with four significant covariates: employment density, the percentage of the student population, the number of sidewalk segments, and the median household income. Compared with the performance of models in existing studies, the performance of the model was solid, with an R^2 value higher than those of the other models.

The equation developed in the study is suitable for application to the study city; the variables selected represent only the best combination of variables that can be used to forecast the mode share for the study city. As discussed before, the other independent variables also have a strong association with the dependent variables. Therefore, for a specific application, it is recommended that the

same methodology be used to analyze the relationship among the variables available and develop the appropriate combination of variables for estimation of the nonmotorized travel mode share.

The spatial level at which this study was conducted is similar to that used in the traditional travel demand model, which offers the possibility of integrating these two models for planning purposes. Although the study concentrated on the commute to work, the same methodology can be applied to other trip purposes, if data are available. If data on other trip purposes are not readily available, the ratio among the home-based trips to work, home-based trips to other destinations, and non-home-based trips associated with nonmotorized travel could be used to estimate nonmotorized travel demand.

The methodology of forecasting nonmotorized travel mode share can be extended to estimate total nonmotorized trips, including trips for other purposes, if data are available. If the relevant data are not available,

the total nonmotorized trips can be derived on the basis of the number of commute-to-work trips and the fact that the nonmotorized commute-to-work trips, including commute to school trips, are responsible for only 5% of all the reported primary purposes of nonmotorized trips during the summer months, according to the 2002 *National Survey of Pedestrian and Bicyclist Attitudes and Behaviors*.

The proposed methodology also has the potential ability to be used for policy testing. For example, the relationship between environmental variables and mode share can provide insight into which type of land use pattern may encourage nonmotorized travel. The association between the nonmotorized travel facility and nonmotorized travel mode share may shed some light on the role of the configuration of the infrastructure in stimulating nonmotorized travel. Such information will benefit planning for both the land use and the infrastructure requirements necessary to meet the needs of the community.

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Reforming State Transportation Policy: Washington State's Efforts to Implement Performance-Based Policies by Michael Ennis (Heritage Foundation, 214 Massachusetts Ave NE, Washington DC 20002-4999; <http://www.heritage.org:80/Research/SmartGrowth/bg2189.cfm>; ph 202-546-4400) (Sep 29, 2008)

Highlights

- The State Auditor's Office conducted a series of independent performance audits on several major aspects of the state's transportation system.
- The audit uncovered \$110 million in potential cost savings and \$3 billion in traffic congestion reduction benefits.

For state leaders to put their transportation systems back on the road to success, they first need to understand their current transportation problems.

In business, measuring performance is a way of life. It is viewed as an indispensable tool that shapes decisions on distributing resources and managing a business. In the public sector, however, performance measures are often collected but rarely used to improve overall management. Rather than using performance measures as a management tool or as a way to set goals that the public can understand and support, performance-based management is treated more like an inconvenience because it might attract attention to the inability to meet ambitious targets. Quantitative measures of performance may also interfere with elected officials' ability to distribute public funds to influential constituencies regardless of value to the taxpayer.

Not knowing how a program or service performs indicates that resources are allocated for political reasons, not for effectiveness. This is especially true in transportation policy.

Across the country, transportation spending decisions are too often tied to political agendas and the wishes of influential constituencies, not objective measures of public need, such as safety and congestion relief. Any hope of implementing a comprehensive regional investment strategy based on cost-effective mobility goals and accountability is ignored as public officials simply hand out (or take away) special favors.

While the legislative process should have the final authority in taxing and spending decisions, basing transportation decisions on anything other than performance inevitably leads to a collage of spending that is at best indirectly related to relieving traffic congestion or improving safety.

Yet a recent development in the state of Washington could very well change how policymakers across the country make decisions on transportation policy. As part of a statewide voter initiative, the State Auditor's Office conducted a series of independent performance audits on several major aspects of the state's transportation system. The findings of these audits could potentially trigger a seismic shift in how state and local governments do business.

In Washington State, the authority to carry out performance audits was created by a state voter initiative (I-900) in 2005, which also defined follow-up steps once a performance audit is completed. These performance audits are to be conducted by the State Auditor, an elected official who operates

independently of the legislature, governor, and all other state agencies.

Under the new law, within 30 days of an audit's release, the governing body of the audited agency must hold a public hearing to consider the audit findings. Next, the state legislature must consider the findings through its appropriations process. The Joint Legislative Audit and Review Committee (JLARC), the legislature's audit committee, must produce an annual report that demonstrates the audited agency's progress in implementing the findings. JLARC must also explain why any recommendations are not being implemented.

In addition to the initiative that authorized the performance audits, Washington lawmakers passed Senate Bill 6839 during the 2006 legislative session and directed the State Auditor's Office to conduct an independent performance audit of transportation-related agencies. The legislature allocated \$4 million for the review.

Before embarking on the audits, State Auditor Brian Sonntag conducted a series of town hall meetings and focus groups across the state to determine which areas in transportation were most important to citizens. Based on those results, the auditor chose to analyze four broad topics: traffic congestion, the ferry system, Washington's Department of Transportation (WSDOT) administration and

overhead, and WSDOT maintenance and construction management. In 2007 and 2008, the State Auditor's Office independently audited these four facets of WSDOT operations, uncovering \$110 million in potential cost savings. The Auditor estimated that implementing the recommendations on reducing traffic congestion would produce \$3 billion in economic benefits.

Conclusion

While some lawmakers are reluctant to relinquish their control over funding transportation projects to a performance-based system, other legislators and state departments of transportation should welcome the new approach. Performance audits can separate areas that are working from those that are not. This information then becomes extremely valuable when deciding how to allocate finite public resources.

The current political system and the uncertainty over whether those decisions will actually reduce traffic congestion will put state leaders further behind in meeting the growing demand on their transportation infrastructure. A Washington-style performance audit, not political agendas, is the key to learning what is working and what is not, so that transportation resources are allocated in a strategic and efficient way.

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Animal-Vehicle Collision Data Collection, NCHRP Synthesis 370 by Marcel P. Huijser, Julie Fuller, Meredith E. Wagner, Amanda Hardy & Anthony Clevenger, Western Transportation Institute, Montana State University, Bozeman, Montana (Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001; (202) 334-3213; <http://gulliver.trb.org/bookstore>) (2007)

Highlights

- This synthesis examines the extent to which animal-vehicle collision data are collected, analyzed, and used.
- Most data are actually collected by law enforcement agencies.
- DOTs mainly have engineers analyze the data using frequency and cluster analyses to identify hotspots.
- A summary of "successful" examples, a list of the needs and benefits of data collection programs & suggestions were formulated.

Animal-vehicle collisions (AVCs) affect human safety, property, and wildlife, and the number of AVCs has substantially increased across much of North America over the last several decades. Systematically collected AVC data help estimate the magnitude of the problem and help record potential changes in AVCs over time. Such data also allow for the identification and prioritization of locations that may require mitigation. In addition, systematically collected AVC data allow for the evaluation of the effectiveness of mitigation measures in reducing the number of AVCs.

In the United States and Canada, AVC data are typically collected by transportation agencies, law enforcement agencies, and/or natural resource management agencies. These activities result in two types of data: data from accident reports (AVC data) and data based on animal carcass counts (AC data). However, not all transportation agencies, law enforcement

agencies, and/or natural resource management agencies record these types of data. Furthermore, the agencies that do record such data often use different methods, resulting in difficulties with data integration and interpretation, and ultimately with the usefulness of the data.

This synthesis examines the extent to which AVC and AC data are collected, analyzed, and used across the United States and Canada. The data were obtained through a survey of departments of transportation (DOTs) and departments of natural resource management (DNRs) for each state or province. For DOTs and DNRs combined, the response rate was 89% (56 of 63 states and provinces).

Most DOTs and DNRs collect or manage AVC or AC data, or both. Most AVC data are actually collected by law enforcement agencies, whereas AC data are typically collected by the DOTs and DNRs themselves. The two agency types have a somewhat different motivation for collecting the data. DOTs primarily collect data to improve human safety (AVC and AC data), for accounting reasons (AC data), and, to a lesser extent, for wildlife conservation reasons (AC data). DNRs are motivated by a mixture of human safety and wildlife conservation concerns (AVC data) or primarily by wildlife conservation concerns (AC data).

Both AVC and AC data typically have reporting thresholds. In addition, the search and reporting effort of the programs varies tremendously between states and provinces and

is not always consistent within a state or province. Furthermore, there is an emphasis on large wild and domesticated animals (deer size and larger), especially in AC data collection programs. These factors typically lead to a substantial underestimation of collisions with animals, both for AVC and AC data.

DOTs typically train their employees in collecting information on date and location of the AVC or AC, but they do not necessarily train their employees in the identification of the species or any other animal-related parameters. DNRs rarely provide training to their personnel, but if they do it is often concerned with animal-related parameters such as species identification, sex, age, and sometimes necropsy. Based on these results, additional training for DOT personnel may have to place more emphasis on animal-related parameters, especially species identification, whereas training for DNR personnel may have to be initiated altogether.

The spatial precision of the AVC and AC data is usually relatively low; typically 0.1 mi/km accuracy, sometimes even less precise. This may pose serious problems when attempting to pinpoint a location that may qualify for mitigation measures. Many DOTs and DNRs are aware of this issue and stress the importance of increased spatial accuracy for the

location of AVCs and ACs; for example, through the use of a global positioning system.

DOTs mainly have engineers analyze the AVC and AC data using frequency and cluster analyses to identify hotspots. DNRs typically have the AVC and AC data analyzed by biologists. DNRs are also interested in identifying hotspots; however, they also use the data to detect wildlife population trends through trend analyses.

DOTs and DNRs identified the lack of a demonstrated need, underreporting, and poor data quality [consistency, accuracy (especially spatial accuracy), and/or completeness], and delays in data entry as the main obstacles to implementing or improving AVC data collection and analysis. Using more standardized procedures, global positioning system technology, faster data entry, centralized databases, and geographic information systems were specifically mentioned to address some of these problems and improve the data collection and data analyses process.

Finally, based on the results of the survey, a summary of "successful" examples, and a list of the needs and benefits of AVC and AC data collection programs, suggestions were formulated for initiating new, or improving existing, AVC or AC data collection programs.

TRANSPORTATION RESEARCH DIGEST

ARIZONA TRANSPORTATION INSTITUTE

e-mail jsemmens@cox.net

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A Guide for Reducing Collisions Involving Young Drivers, NCHRP Report 500, Vol. 19 by Arthur Goodwin, Robert Foss, Jamie Sohn & Daniel Mayhew (Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001; (202) 334-3213; <http://gulliver.trb.org/bookstore>) (2007)

Highlights

- Strategies most likely to be effective in reducing crashes involving young drivers are recommended.

Based on an extensive review of tried and tested strategies, the following is a summary of strategies most likely to be effective in reducing crashes involving young drivers.

Graduated Driver Licensing Systems

Most states have implemented graduated driver licensing (GDL) systems, but it is important for GDL systems to include the most beneficial risk-reducing restrictions, including the following:

- Enact a full GDL system. GDL is designed to provide beginning drivers with substantial driving practice under the safest possible conditions, exposing them to more risky situations only as experience is gained over time.
- Require at least 6 months of supervised driving for beginners, starting at age 16. A substantial amount of practice is needed before a novice driver begins to develop the savvy required to be a proficient and safe driver. Driving with an adult supervisor enables novice drivers to gain needed "real world" driving experience in a reasonably safe fashion.
- Implement a nighttime driving restriction. A disproportionately high number of young driver fatal crashes

occur between the hours of 9 p.m. and 6 a.m. Beginning drivers should not be exposed to the most risky driving conditions.

- Implement a passenger restriction allowing no young passengers. Carrying teen passengers greatly increases the risk of a serious crash for young drivers. Passenger restrictions for the first several months of unsupervised driving eliminate the distractions that teen passengers inevitably create.
- Prohibit cell phone use by drivers with a GDL license. Recent research suggests that using a cell phone is associated with a fourfold increase in the likelihood of a serious crash among drivers of all ages.

Laws Pertaining to Young Drivers

Enhanced publicity, enforcement, and adjudication of young driver laws, including the following measures, will benefit young drivers:

- Publicize and enforce GDL restrictions. To the extent that teens do not comply with protective restrictions under GDL systems, the safety benefits of GDL will be reduced.
- Publicize and enforce laws pertaining to underage drinking and driving. Both minimum drinking age laws and "zero tolerance" laws have proven effective in reducing alcohol-related crashes and fatalities involving young drivers.

- Publicize and enforce safety belt laws. Safety belt use is lower among young drivers than among adult drivers. Well-publicized enforcement programs and primary safety belt laws have increased belt usage for all drivers, including teen drivers.

Assist Parents

Efforts to assist parents, including the following, can benefit teen drivers:

- Facilitate parental supervision of learners. More effective supervision of teen drivers holds substantial promise for further reducing young driver crashes. Simply distributing educational advisory materials to parents is insufficient. Persuasive techniques that encourage parents to make use of materials and guidance are needed.
- Facilitate parental management of intermediate drivers. Teen drivers experience a dramatic increase in crashes when they first begin driving alone. Parent-teen driving agreements and new technologies for monitoring teen drivers have the potential to reduce young driver crashes during this high-risk period.
- Encourage selection of safer vehicles for young drivers. Teens often drive vehicles that are less likely to have important safety features. A program that encourages the greatest possible use of safer vehicles by young drivers holds substantial promise for reducing deaths and injuries among teen drivers and their passengers.

Improve Young Driver Training

Although there is no evidence that formal driver education classes are effective in reducing subsequent crash rates among novice drivers, there are a number of promising improvements that can be made in the training of young drivers administered by states. The model followed by current driver education programs in the United States was developed in the late 1940s. There is widespread belief that both what is taught and how it is taught can be improved significantly, with the promise that young driver crashes can be reduced as the result. Doing so will require a substantially more ambitious effort than simply adding content to the current curriculum.

Employ School-Based Strategies

Nearly all beginning drivers are in high school. This affords an opportunity to adopt strategies to reduce young driver crashes by implementing policies that take advantage of this natural grouping in both space and time to alter that environment:

- Eliminate early high school start times. Recent developments in understanding human sleep needs indicate that teenagers need to be asleep in the early morning hours. As a result, school systems in the United States have begun to move school start times back to 8:30 or later. This promises to reduce young driver crashes.
- Review transportation plans for new/expanded high school sites. When new schools are built, transportation plans should take into account that there will be a high concentration of inexperienced teens driving in the vicinity of the high school.

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ARIZONA TRANSPORTATION INSTITUTE

e-mail jsemmens@cox.net

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The Impact of Legislation, Enforcement, and Sanctions on Safety Belt Use, NCHRP Report 601 by James Nichols & Katherine Ledingham (Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001; (202) 334-3213; <http://gulliver.trb.org/bookstore>) (2007)

Highlights

- ❑ Studies of the impact of primary law upgrades on fatalities have shown a median 7% to 8% decline in fatalities.
- ❑ The effectiveness of sanctions is not as well documented.

This review focuses on the impact of legislation, enforcement, and sanctions in increasing safety belt usage (SBU). It finds strong and consistent evidence of past and current legislative and enforcement efforts, as well as consistent evidence suggesting the importance of sanctions. All three measures must be publicized to maximize their potential for impact.

The earliest SBU laws were associated with a median 32% increase in observed usage, from baselines of 16% to 18%. Increases were greater in states that allowed for primary enforcement and, in those states, they were greatest when enforcement and/or sanctions were present. In general, these early laws affected lower-risk groups -- (e.g., females, adults, urban and late-night motorists, etc.) to a greater extent than higher risk groups (e.g. males, teens, rural and daytime motorists, etc.), thus increasing the usage gap between such groups. These laws coincided with 7% to 9% reductions in fatalities and 13% reductions in injuries. These reductions were lower than expected, based on the magnitude of increases and the known effectiveness of safety belts against deaths.

From January; 1993 through February 2007, 18 jurisdictions upgraded their secondary

enforcement laws to allow for primary enforcement. These upgrades were associated with a median 13% to 16% increase in observed SBU, from a median baseline of about 65% (range: 52% to 83%). Recent upgrades, those implemented since 1999, were associated with somewhat smaller gains (median = 11%), compared with pre-2000 upgrades (median = 16%). With regard to usage among occupants killed in crashes, these upgrades were associated with a median increase of 8% (range: -1 to +21), with recent upgrades associated with gains that were slightly larger than those of earlier upgrades (+10 versus +7, respectively). In contrast to results concerning initial laws, studies of primary law upgrades suggest that they affect higher risk groups to the same (or greater) extent as they affect lower risk groups, thus decreasing the usage gap between these two risk groups. There also is recent evidence that upgrades affect usage among drinking drivers and among occupants killed in late-night crashes. In some cases these increases have been greater than among non-drinking drivers and occupants killed in daytime crashes.

Studies of the impact of primary law upgrades on fatalities have shown a median 7% to 8% decline in fatalities, greater than would be predicted based on the measured change in usage (observed or among crash victims). This finding is consistent with a relatively greater impact on high-risk occupants. Using changes in usage among crash victims (median = 9.7% in recent upgrades), it is estimated that future upgrades would be associated with 4% to 5%

fewer deaths and 6% fewer moderate-to-serious injuries. The average annual savings (per state) would be about \$138 million. Of course, there is a large range associated with this estimate, with large and populous states experiencing greater savings than smaller, less populous, and usually rural states.

Most recent upgrades have been implemented in conjunction with high visibility enforcement (HVE) efforts, usually as part of national Click It or Ticket (CIOT) mobilizations. Thus, reported impact is often associated with a combination of legislative, enforcement, and publicity efforts. This combination of law upgrades and repeated HVE has provided some of the largest impacts in observed use and use among crash victims.

Highly visible enforcement, usually in the form of periodic waves of intensified enforcement and publicity (blitzes), also has been consistently associated with large and significant increases in observed usage. At the local level, a review of more than 25 HVE programs resulted in a median increase of about 13% (range: -7 to 41), usually from low-to-modest baseline rates. Benchmark programs provided increases as high as 41%, from a median baseline of about 54% usage (range: 25% to 72%). The impact associated with HVE generally followed a ratcheting or saw-blade pattern, with large initial increases followed by modest declines, followed by additional increases and modest declines with each subsequent HVE effort. Generally, usage rates stabilized following repeated waves of HVE (e.g., in North Carolina).

Based upon these studies of local HVE efforts, it appears that: a) sustained enforcement was as effective as blitz enforcement and it was usually associated with less abrupt decay in both enforcement and usage following program completion; b)

publicity was essential for program impact, with paid ads associated with greater increases than other forms of media activity, but with earned media (i.e., efforts to generate local news stories) also essential for maximum impact; c) daytime enforcement generally affected daytime usage more than late night usage, while nighttime enforcement affected late-night usage (sometimes among bar patrons) more than daytime usage; d) non-sanction approaches, where police attempted to increase usage by means of positive messages and gestures rather than with warnings or citations, were generally ineffective; e) checkpoints and/ or roadblocks were nearly always associated with large observed impacts; f) median intensity of enforcement was 54 citations per 10,000 residents (range: 20 to 140); g) median intensity of paid media efforts (where reported) was 36¢ per capita (range: 26¢ to 38¢) and h) median awareness of enforcement efforts (where reported) was 49% (range: 10% to 90%).

The effectiveness of sanctions is not as well documented as the effectiveness of laws and HVE. Clearly, initial laws were more effective when sanctions were in effect than when they were not in effect. In addition, early research showed a positive relationship between the magnitude of a fine and usage among crash victims. There is consistent evidence that these relationships between sanctions and impact were greater in primary law states than in secondary law states. Impaired driving studies also suggest a positive relationship between sanctions and impact on fatalities. Thus, while insufficient research has been conducted with regard to the impact of sanctions on SBU, it is likely that publicized increases in sanctions would increase the impact of upgrades and HVE efforts.

TRANSPORTATION RESEARCH DIGEST

ARIZONA TRANSPORTATION INSTITUTE

e-mail jsemmens@cox.net

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Safety Impacts of Access Management Techniques in Utah by Grant G. Schultz, Jeff S. Lewis, and Tim Boschert in *Transportation Research Record 1994* (Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001; (202) 334-3213; <http://gulliver.trb.org/bookstore>) (2007)

Highlights

- ❑ Access management techniques may not always result in a reduction in overall crash rates.
- ❑ However, the changes in crash patterns and severity prove the techniques to be effective.
- ❑ In general, the no-injury crashes increased, and the more severe crashes decreased as percentages of total crashes.

Traffic volume and congestion across the state of Utah have continued to increase in recent years, particularly on arterial streets. The *AASHTO Policy on Geometric Design of Highways and Streets* (AASHTO Green Book) states "arterials are expected to provide a high degree of mobility for the longer trip length. Therefore, they should provide a high operating speed and level of service. Since access to abutting property is not their major function, some degree of access control is desirable to enhance mobility."

The primary function for arterial streets as defined in the AASHTO Green Book is to provide mobility. Providing access to abutting property, however, is a very important function that must be considered. An increase in traffic volumes combined with the desire to provide access to adjacent properties can have a negative effect on the safety and operational characteristics of these roadways. When unlimited access is provided to adjacent properties, the result oftentimes is a decrease in speed, level of service, and, more importantly, safety. In an effort to combat the safety concerns associated with this access, specific

techniques have been implemented to control access and improve safety. These "access management" techniques are defined as "the systematic control of the location; spacing, design, and operation of driveways, median openings, interchanges, and street connections to a roadway."

In recent years, there has been an increased emphasis on the implementation of access management principles and techniques in the state of Utah. In 2003, the Utah Department of Transportation (UDOT) established a state law to help control access management as part of the Administrative Rule R930-6: *Accommodation of Utilities and the Control and Protection of State Highway Rights of Way*. This administrative rule establishes the basis for including access management principles as a part of the issuance of driveway and street access permits.

One of the topics addressed in the administrative rule is that of raised median installation as an access management tool. The increase in congestion on arterial streets has led to the installation of raised medians as a strategy to reduce conflict points and improve safety. A 2004 study completed at Brigham Young University for UDOT began the process of evaluating raised medians as a proposed safety initiative in the state (4). The results of this research established a procedure to guide state engineers through the evaluation process of identifying the need for a raised median on a given roadway segment.

As a follow-up to the research performed at Brigham Young University, a

second project with the objective of further evaluating the safety effects of access management treatments by investigating crash data from a representative sample of corridors across the state of Utah where access management techniques (i.e., raised medians or driveway consolidation) have been implemented was performed. The primary method for estimating and quantifying the safety effects was through the use of the UDOT geographic information system (GIS)-enabled, web-delivered data almanac (i.e., crash database) to compare crash rates before and after installation of access management techniques, along with comparative data from a number of control sites across the state.

Conclusions

The research performed outlines the background of access management techniques as a procedure to improve safety conditions on arterial streets. The results of the study show that access management techniques (i.e., raised medians or driveway consolidation) may not always result in a reduction in overall crash

rates; however, the changes in crash patterns and severity prove the techniques to be effective. Generally, severity of crashes and the corresponding costs associated with these crashes decreased after access management techniques were installed. The reduction in the severity of crashes was anticipated to be a direct result of the change in the predominant types of collisions. Rear-end and single-vehicle crashes generally increased, whereas right-angle crashes decreased as a result of the raised median installation. The reduction in right-angle crashes directly resulted in a reduction of the severity of crashes and improved the safety on the roadways where raised medians were installed. In general, the no-injury crashes increased, and the more severe crashes decreased as percentages of total crashes. This reduction in severity translated to a reduction in the total cost of crashes (economic benefit) as a result of the raised median installation. Overall, the results showed that a safer roadway was created by the installation of access management techniques.

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ARIZONA TRANSPORTATION INSTITUTE

e-mail jsemmens@cox.net

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State DOT Crash Reconstruction Practices, NCHRP Synthesis 369 by Jerry G. Pigman & Kenneth R. Agent, Kentucky Transportation, Center University of Kentucky, Lexington (Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001; (202) 334-3213; <http://gulliver.trb.org/bookstore>) (2007)

Highlights

- The primary objectives of this synthesis were crash reconstruction activities conducted by state DOTs, feedback provided from these reconstruction actions, and mitigation actions taken as a result.
- Very few state DOTs conduct crash reconstructions on a routine basis.

Crash reconstructions are routinely performed by law enforcement agencies, typically for determination of liability or fault by drivers and possible criminal actions, but only occasionally by state departments of transportation (DOTs). State DOTs use crash data for assessing the safety of roadway sections and spots and may conduct crash reconstructions to assist with this assessment. A state DOT may also do a crash reconstruction as part of the defense of a claim against the agency. The extent of crash reconstruction by state DOTs and the level of expertise available to perform these tasks has not been documented. In addition, it is not known to what extent crash reconstructions are used by state DOTs to improve highway safety. This synthesis of the state of the practice in crash reconstruction as it involves state DOTs is intended to address these issues.

The primary objectives of this synthesis were crash reconstruction activities conducted by state DOTs, feedback provided from these reconstruction actions, and mitigation actions taken as a result. An attempt was made to determine the level of intra- and interagency

communication, as well as education and training opportunities. This synthesis also addressed knowledge gaps and future research needs to assist state DOTs when performing crash reconstruction.

Crash reconstruction is defined as a process using specialized skills beyond typical police crash reporting to document and analyze the events leading to a collision and/or the cause of a collision. Law enforcement agencies use reconstruction data to support criminal investigations; however, it is assumed that the primary uses by DOTs are to identify highway safety problems and initiate countermeasures or improvements, or in defense in instances of litigation against the DOT.

The literature search determined that there has been little attempt to assess the use and benefits of crash reconstruction by state DOTs. Crash reconstruction practices that have been adopted and used by state highway agencies are typically related to managing risk associated with highway crashes involving transportation facilities. It is generally agreed that the goal of highway risk management should be to achieve effective and efficient transportation while minimizing risk of human injury and loss. A comprehensive risk management program was identified as a key element for allocating resources to achieve effective and efficient transportation while minimizing that risk. Reconstruction of highway crashes has been cited as one of the tools that can be used by state DOTs to manage that risk. It was noted that even though law

enforcement personnel typically investigate highway crashes, there are circumstances where it would be advantageous for highway agencies to conduct their own investigations.

It was determined from a survey that the level of involvement in crash reconstruction by state DOTs was relatively minor. Of the 26 states returning the survey, only 6 (California, Delaware, Kansas, Kentucky, Oklahoma, and West Virginia) indicated that they had a unit or assigned personnel (including contractors) that performed crash reconstruction on a routine basis. Other states indicated that they hired consultants as needed to prepare crash reconstructions as part of specific litigation. The number of personnel involved ranged from one in West Virginia and Oklahoma to eight in California and Delaware (with two in Kentucky and five in Kansas).

A wide range of requirements were noted for the six states responding to the survey that indicated DOT personnel or consultants performed crash reconstruction. Basic measuring tools were frequently cited, along with reconstruction software and engineering design software that could also be used for crash reconstruction.

It was generally indicated that crash reconstruction was performed by the state police and information from that investigation was then used by the state DOT. The lack of crash reconstruction conducted by DOTs shows the need for communication and cooperation between DOTs and law enforcement agencies.

The primary justification for crash reconstruction was liability concerns. Similarly,

criteria used to decide whether to reconstruct a crash typically included a potential claim or suit against the DOT, with severity of the crash and involvement of a government employee or property as secondary factors. Data from the reconstructions were typically used to improve traffic safety through system-wide improvements, specific site improvements, traffic engineering applications, and to complement a risk management program. Responses from the six states that submitted detailed responses indicated that only California had no limits for tort actions and that Delaware was one of only six states remaining with full sovereign immunity. Liability limits for each individual occurrence ranged from \$350,000 in Kentucky and \$500,000 in Kansas to \$1,000,000 in both Oklahoma and West Virginia. Employees' discretionary acts are covered to some degree by sovereign immunity in all six states.

In summary, very few state DOTs conduct crash reconstructions on a routine basis. The lack of DOT crash reconstructions and their reliance on data from law enforcement shows the need for effective communication between the DOT and law enforcement and the need for training to ensure that law enforcement personnel properly recognize highway related issues. The procedures used in California and Delaware demonstrate that a team approach between the DOT and law enforcement can be achieved and illustrates the opportunity lost by other state DOTs that do not use this approach.

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ARIZONA TRANSPORTATION INSTITUTE

e-mail jsemmens@cox.net

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Traffic Control Devices and Barrier Systems at Grade Crossings by Michelle Yeh and Jordan Multer in *Transportation Research Record 2030* (Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001; (202) 334-3213; <http://gulliver.trb.org/bookstore>) (2007)

Highlights

- ❑ Lowering the height of the crossbuck sign from 9-ft to a height similar to a "Stop" or "Yield" sign would improve nighttime conspicuity.
- ❑ Drivers were more likely to commit a crossing violation as warning time increased beyond 20 seconds.
- ❑ External cues, such as the sound of a train horn, in conjunction with a warning signal, may help drivers discriminate between reliable and unreliable warnings.

Safety at grade crossings has improved considerably over the past 10 years, but improving driver behavior at grade crossings remains a significant challenge. The literature review highlighted that both unintentional human errors and intentional violations contribute to noncompliance. With respect to human error, drivers may fail to detect the grade crossing or fail to understand the action required. With respect to violations, drivers violate crossings in part because they perceive the warning device to have low credibility.

To prevent driver error, countermeasures have been implemented to improve the conspicuity of warning signs. The MUTCD requires application of reflective sheeting on the front and back along the full length of the crossbuck posts to facilitate detection as well as to reflectorize the crossbuck. Lowering the height of the crossbuck sign from the 9-ft (2.8-m) requirement in the MUTCD to a height similar to a "Stop" or "Yield" sign would improve

nighttime conspicuity by reflecting more light from a vehicle's headlight beam.

Alternative warning sign systems have also been evaluated to improve drivers' understanding of the action required at a crossing. The MUTCD allows the use of "Stop" or "Yield" signs at passive grade crossings where two or more trains operate daily. Motorists universally recognize the "Stop" and "Yield" signs, but their use at grade crossings is controversial. Compliance with "Stop" signs at grade crossings is low, and a question remains about whether the "Stop" or "Yield" sign would improve compliance relative to presentation of the crossbuck alone. Conducting research to determine whether drivers' response to the "Stop" and "Yield" signs at grade crossings would adversely affect the general highway situation and the conditions under which this might occur may be worthwhile.

Observations at active grade crossings indicate that drivers violate active warning signals. To prevent drivers from intentionally violating the crossing, highway engineers placed barrier systems at selected grade crossings along high-speed rail corridors. These systems are expensive, but installation of barriers at select crossings using a corridor-based approach to improving safety represents an effective way to balance safety countermeasures with limited financial resources.

Compliance may also be improved implicitly by improving drivers' perception of signal credibility. Drivers were more likely to commit a crossing violation as warning time

increased beyond 20 seconds or if they perceived the signal to have a large number of false alarms. No maximum warning time has been specified, but having reasonable and consistent waiting times by implementing constant warning time systems will encourage compliance. The false alarm rate may be reduced through improvements in track circuitry and train detection equipment, the incorporation of good maintenance practices, and the identification and correction of signal malfunctions in a timely manner. Continued research is recommended to identify the factors that motorists use to judge signal reliability. In particular, external cues, such as the sound of a

train horn, presented in conjunction with a warning signal, may help drivers discriminate between reliable and unreliable warnings.

The design of traffic control devices is only a small piece of the problem. An examination of driver behavior at grade crossings, from a systems perspective, highlights the need to consider other elements and their interactions with one another. These issues, considered in the report from which this paper was adapted, provide a framework for examining driver behavior at grade crossings and an approach for implementing countermeasures to improve safety.