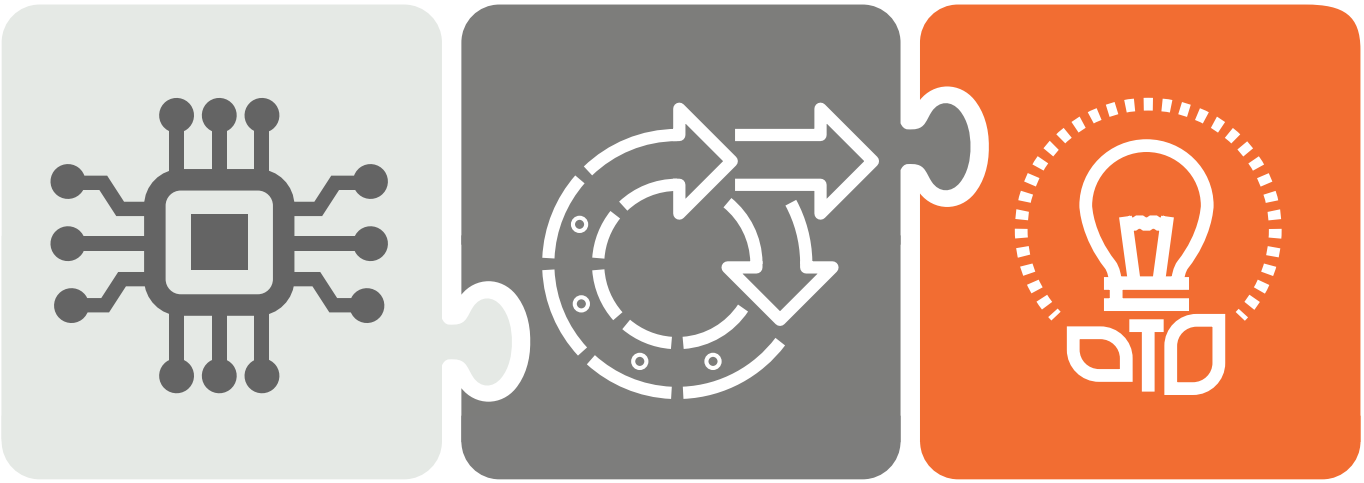


PREPARING FOR THE FUTURE, BUILDING RESILIENCE

FINDINGS FROM THE TRANSPORTATION RESEARCH BOARD'S 2017 STATE PARTNERSHIP VISITS PROGRAM

The Technical Activities Division of the Transportation Research Board (TRB) conducts the State Partnership Visits Program, in which TRB staff visit state departments of transportation (DOTs), university transportation centers, transit and other modal agencies, and private industry. The purpose of these visits is to exchange information on what TRB is doing to foster transportation research, as well as on what the states are researching and how they are implementing completed research. Founded in 1945, the partnership visits program has a rich tradition of strengthening the bond between TRB and its state sponsors.

TRB recruits staff from all facets of the transportation field. Senior program officers are chosen based on their education and experience in one or more areas of interest to the TRB community. Besides engineers, TRB staff includes planners, writers, historians, attorneys, economists, mathematicians, geologists, geographers, and political scientists. Most staff officers have professional experience in their field of expertise in the public or private sector or both. They bring detailed knowledge of their chosen field to TRB, including knowledge of current issues and trends that might affect state DOTs.

The Partnership Visits Program's annual cycle begins with a questionnaire, sent to DOTs in each state and in the District of Columbia. Agencies are asked what areas of transportation they would like to focus on during the visit; TRB staff members are selected based on their experience in these focus areas, as well as on their recent state visit history. Each TRB staff member is assigned two or three states each year and develops visit plans with the DOT's state representative to TRB. Staff members are rotated among states to avoid repetition; indeed, it has been said that if one works at TRB for about 20 years, they will have an opportunity to visit every state in the country.

State visits last one or two days and typically consist of face-to-face meetings with upper management; discussions with DOT staff involved in various topic areas; exchanges of issues and ideas; and, often, a visit to DOT facilities or sites of ongoing projects. Technical Activities Division staff members have contributed to the following summary of the issues covered in the 2017 state visits.

Photo: Coast Guard News, Flickr

U.S. Coast Guard crews repair navigational aids after Hurricane Harvey. Preparing infrastructure to withstand extreme weather continues to pose a challenge for transportation agencies.

Planning

The field of planning faces a crossroads: establishing performance goals that guide current transportation plan development and making preparations to accommodate a rapidly changing transportation future. State DOTs, transit agencies, and metropolitan planning organizations are developing performance-based plans, performance measures, and targets in accordance with federal law and regulations. Several critical deadlines for establishing performance targets occur in early 2018 and are therefore a predominant focus. Agencies recognize the benefits of performance-based planning and management in creating efficient transportation project planning and delivery.

Another area of focus among planning agencies is preparing for future automation in transportation, particularly for connected and automated vehicles (CAVs). As it becomes more commonplace for online applications to dispatch mobility services and for drones to deliver everything from packages to pizza, many transportation agencies envision a largely automated future.

The transformation of automation often is visualized in phases—from CAV 1, or some automation in vehicles, to CAV 5, or fully engaged automation with no driver assistance. The question no longer is whether transformation will occur, it is when the various phases will take place—and, more importantly, what the government's role is in preparing for them.

Although state DOTs are enthusiastic about the benefits of transformational technologies, practitioners and members of the academic community have many unanswered questions as to how governments should prepare for the arrival of the technologies. Issues prompting research include the impacts of automation on land use and the potential for sprawl; workforce impacts; and equity of access, particularly for low-income and other underserved populations.

For many planning organizations, one last area of focus is planning for resiliency. The ability of infrastructure to withstand the devastation of extreme weather events is a vexing concern for many states and large metropolitan areas. Planning for emergencies requires collaboration among a variety of public-sector agencies. Technology can provide a critical communications link between organizations and the public they serve.

Data

Technology advances are increasingly important to state DOTs—technology was the most-requested area of expertise for the 2017 state visits. Because quality data are expensive and time-consuming to maintain, many states are developing data business plans to guide their investments both in data collection and in staff costs to manage the data.

The correlation of different data sources is a vital concern, as is developing a better understanding of how data are used in policy decisions. Both the timeliness of data and the use of understandable formats are key factors in the successful deployment of transportation data.

Big data and data analytics are emerging issues for many states. The new governor of Iowa, Kim Reynolds, has made data analytics a statewide priority and has asked Iowa DOT to lead that effort. Recruiting and maintaining DOT staff with data-management capabilities remains a challenge.

Aviation

The potential for changes to the management of the U.S. air traffic control system, and the implications of these changes, continue to cause heated debate throughout the aviation community. State DOTs, which own many airports, are trying to better understand how general-aviation airports may be affected and what role they and other stakeholders will play if air traffic control management shifts from public to private.

Photo: Tomas del Coro, Flickr

Shifts in air traffic control from the public to private sector is a topic of debate in the aviation industry.

States also are absorbing more roles and responsibilities for unmanned aircraft system operations and are seeking innovative ways to use the technology to help support various services, including inspection, maintenance, and mapping—while managing the challenges of ensuring and enforcing safe operations in the vicinity of airports and populated communities.

Freight

As state DOTs look for innovative approaches to enable efficient freight mobility, many are incorporating plans to research, test, and implement various technology solutions as part of state freight strategic plans. Alabama DOT has identified a list of eleven available technologies in its statewide freight plan that best serve freight mobility—among them adaptive signals, vehicle detection systems, and weigh-in-motion equipment.

Idaho DOT also is exploring freight-enabling technology, with a pilot that will outfit several intersections with the ability to leverage vehicle-to-infrastructure technologies—for example, the use of radar technologies to capture information on types and levels of traffic, particularly freight traffic. Practices such as delayed-yellow timing when trucks are identified can reduce red-light violations, helping to mitigate congestion and increase safety. The Idaho Statewide Freight Plan also contains several projects to extend weigh-in-motion capabilities by upgrading technology in both mobile enforcement units and fixed pavement locations.

Texas DOT's Freight Advanced Traveler Information System (FRATIS) demonstration project is being deployed in the Dallas–Fort Worth area and along the I-35 corridor. To optimize truck drayage operations, FRATIS facilitates the real-time sharing of information between terminal operations, vehicle dispatchers, and truckers, and provides information on terminal queue times, optimal routing, construction, traffic delays, and weather.

Ports and Waterways

Although the popular notion is that most U.S. seaports are gearing up for the age of the megaship and for surges of containers, many small- and medium-sized ports are leveraging their particular state and regional markets to vary their portfolios and to thrive as niche ports for certain commodities.

At the Port of Mobile, Alabama, the volatility of the coal market has prompted the maintenance of

Idaho's weigh-in-motion technology captures and records the weight of vehicles traveling at normal traffic speed, allowing trucks to bypass weigh stations.

Photo: Idaho DOT

Photo: Corey Templeton, Flickr

The Eimskip cargo ship *Skogafoss* departs Portland Harbor, Maine. Through tailored facilities and business processes, the Port of Portland has developed strong regional supply chain relationships with Eimskip and with local retailers like L.L. Bean.

a diverse portfolio, ranging from steel and forest products to bulk liquids and frozen poultry. Using an automated handling system at its purpose-built Pinto Island Terminal, the port has the unique capacity to transload finished steel slabs directly from ships to barges. This one-of-a-kind facility was developed specifically to serve an Alabama steel mill located roughly 50 miles from the port. The port's ability to react to this regional economic development opportunity was key to the steel mill's decision to locate in Alabama.

Similarly, at the Port of Portland, the Maine Port Authority has established regional supply chain relationships with Maine-based outdoor outfitter L.L. Bean as well as with Iceland-based carrier Eimskip, which handles refrigerated products such as imports of frozen fish from Northern Europe and exports of frozen Maine lobsters. In both instances, by tailoring its facilities, operations, and business processes to provide more efficient service for these niche product supply chains, the Port of Portland was able to lure business from other East Coast ports.

Rail

Shipments of crude oil by rail continued to decline in 2017, as petroleum market price fluctuations and pipeline construction placed downward pressure on this form of traffic. Traditionally a traffic staple for the railroads, coal production continued its decade-long drop—although there are signs that the rate of decline may be slowing. The loss of rail traffic in these markets has been partially offset by increases in intermodal, automotive, and merchandise traffic. Service issues continue to plague the industry as the large railroads try to cut costs and as calls for new economic regulation continue.

The upcoming year will pose challenges, with the upcoming deadline for implementation of positive train control (PTC). Although railroads and transit agencies have spent millions of dollars to prepare for the deadline, accidents that might have been prevented by PTC continue to occur. The mandate for electronically controlled pneumatic brakes on certain trains was rescinded after studies found that

Photo: Clint, Flickr

Loss of rail traffic from declines in coal production has occurred along with the challenges of cost-cutting and new regulations.

the benefits of the technology do not outweigh the costs and disruption associated with it.

In many parts of the country, state-supported passenger service continues to be successful—service is expanding and new equipment is being acquired. Amtrak welcomed new leadership in 2017 and ridership remains strong. Planning and construction for new intercity services—some of them high-speed—continued in Florida, Texas, and California.

Public Transportation

State DOTs are evaluating ways to take advantage of transportation network companies (TNCs) and are discussing the evolution and potential impact of TNC regulation. States also must determine the best way to engage with TNCs and are considering the relationship between TNCs and public transportation. The District of Columbia DOT curbside management program is weighing "transportation hubs"—consolidating bus stops, bikeshare stations, and taxi and TNC pick-up and drop-off locations.

State DOTs also are examining possible CAV impacts on the transportation network and continuing to invest in public transportation. In Oklahoma, transit is a major consideration in city revitalization and in facilitating accessible and livable communities. As part of a downtown revitalization project, Oklahoma City is installing a new streetcar system and also has begun to study the potential of automated streetcars. The District of Columbia DOT is exploring an innovative, data-driven transit planning process to prioritize infrastructure and route-level improvements.

Several TRB committee members were invited to participate in a research peer exchange with Florida DOT that focused on emerging technologies, automated vehicles, and big data. Participants included staff from TRB, the American Association of State Highway and Transportation Officials, the Federal Highway Administration, the Federal Transit Administration, state DOTs, universities, and private-sector firms. The theme of the peer exchange was to discuss state DOT research roadmaps in the context of national activities and emerging technologies, exploring how a state program can be aware and relevant in a fast-paced national environment.

Florida is home to at least six CAV test beds in Florida, with an estimated 11 more across the country. The City of Gainesville, Florida DOT, and the University of Florida have launched a joint endeavor to manage an advanced traffic-control test bed in Gainesville—one that accommodates automated vehicles in the traffic mix. In conjunction with the University of Florida and Florida DOT, the Hillsborough Area Regional Transit Authority will begin testing an automated shuttle bus this year. The City of Jacksonville is modifying its fixed-guideway people-mover to provide access to other automated vehicles.

Photo: Washington Area Bicyclist Association, Flickr

District of Columbia DOT is considering installing transportation hubs, with bus stops, bikeshare stations, and taxi services all accessible in one location.

Environment, Energy, and Climate Change

Recent declines in staffing levels are prompting state DOTs to evaluate how best to meet environmental goals and requirements. Now that states can assume the responsibility for National Environmental Policy Act review and approval processes under SAFETEA-LU and MAP-21, many state DOT environmental departments are learning from the experience of early adopters as they evaluate ways to meet the increasing demand for streamlined business practices.

Technological tools also are being explored further—not only to examine the future environmental impacts of transportation projects, but also to analyze existing impacts more effectively and potentially to reduce them. From drones and lidar used in monitoring to analyzing impacts with geographic information systems and other improved modeling tools to facilitating the use of alternative power sources such as solar, electricity, and hydrogen, states are talking collectively about the challenges and opportunities posed by these new and improving technologies in the field of environmental mitigation.

Oregon DOT employees relocate fresh creek mussels in advance of a bridge project. State DOTs must evaluate the environmental impacts of transportation projects.

Photo: Oregon DOT

Legal

Attorneys representing state DOTs handle myriad legal matters that range from routine to extraordinarily complex in subject areas including environmental law; eminent domain; permitting; contracts, from routine procurements to multimillion-dollar construction projects; civil rights; statutory and regulatory drafting; and driver and vehicle issues.

In keeping with the priorities of their clients, state DOT attorneys are engaged in the adoption and integration of transformational technologies into state transportation systems by helping states delineate their legal authority and that of the federal government—and the gray areas in between. Of particular concern are data privacy and security issues associated with connected and autonomous technologies and liability issues associated with potential tort actions involving CAVs, unmanned aerial vehicles, and associated infrastructure.

States and local governments continue to deploy innovative project delivery methods, including public–private partnerships, to help meet critical infrastructure needs. These innovative financing options often pose challenging policy and legal issues to be resolved by DOT attorneys—particularly in states in which user fees or tolls are disfavored or in which constitutional restrictions on debt exclude such options as availability payments.

Critical infrastructure needs, new technologies, and innovative project delivery methods can raise legal issues on the environmental front. The organizational stresses associated with a need for expedited NEPA processes challenge DOT attorneys to find ways both to address their clients' needs and to preserve the integrity of the applicable laws and regulations.

Highway Design

To reduce run-off-the-road crashes and other incidents, states are working to increase the effectiveness of roadside safety design countermeasures like high-friction surface treatments on roadway curves; innovative bridge rail and cable median barriers; and protection for vulnerable facility users like pedestrians, bicyclists, and motorcyclists.

Other simple and effective design countermeasures—for example, pavement edge drop-off treatments in Iowa and centerline rumble strips in Louisiana—also are finding widespread application throughout the country. Centerline rumble strip countermeasure data from Louisiana indicate an approximately 40-percent reduction in cross-centerline crashes, with a three-year study showing a nearly ten-to-one benefit–cost ratio.

Financial constraints continue to challenge design engineers to develop cost-effective designs that meet the demands of infrastructure replacement, rehabilitation, or both. Fiber-reinforced polymers (FRP) are finding application in many pavement and bridge projects; this may include FRP-reinforcing bar or dowel joints in reinforced concrete pavements or lightweight FRP structural elements in bridges.

In a majority of U.S. states, between 5 and 9 percent—or more—of bridges are rated as structurally deficient. In West Virginia, bridge decks have been designed with FRP to reduce the load and thereby increase design efficiency; West Virginia DOT also has rehabilitated many bridges using FRP wraps on substructure elements.

Highway Construction and Materials

Under e-construction initiatives, state DOT workforces have been equipped with mobile devices to

PHOTO: VIRGINIA DOT

The use of centerline rumble strips has resulted in a significant reduction in cross-centerline crashes. Positive results in Louisiana further support the increased application of this countermeasure for improved safety.

update construction drawings electronically and to inspect projects faster. Research is verifying the match-up of 3-D drawings and the accuracy of electronic grade control; some exploratory projects use only 3-D models as contract documents.

Data and functionality enhancements for e-ticketing systems help improve materials production and placement. Also being researched are emerging technologies, such as sensors that link construction vehicles and worker safety gear for proximity warning.

Alternative project delivery methods increasingly are used instead of design–bid–build in complex projects with critical schedules—for example, Georgia DOT's Major Mobility Investment Program to reduce long-term corridor congestion.

To improve and increase the use of recycled materials, agencies are incorporating engineering properties into specifications and pavement design procedures, including base mixes made from nearly 100-percent recycled asphalt pavement (RAP) with foamed asphalt binder or recycled concrete as an aggregate. When contractors follow state DOT–developed guidance that stipulates adjustments to RAP proportions for performance, conventional asphalt mixes of up to 30-percent RAP have been produced.

Internally cured concrete, which experiences less shrinkage and cracking because of better cement hydration, is being implemented in trials with local agencies. High-performance concrete mix designs replace some cement with such alternative materials as silica fume, slag, limestone, and fly ash for added durability and sustainability.

Material quality tests are being updated for ground tire rubber in asphalt binder creep and recovery and concrete resistivity testing for newer cements.

Geotechnical Engineering

Geotechnical resilience in the face of extreme weather events continues to challenge the transportation community, with expansive soils considered a common cause of pavement distress in many states. Louisiana Department of Transportation and Development is examining the effects of severe drought on compacted expansive clays, researchers in Texas looked at stabilizing expansive clays in pavement applications using geosynthetics, and Oklahoma DOT is investigating the performance of moisture barriers in pavement construction on top of expansive soils.

Heavy rainfall increases soil moisture and slope stability problems. Minnesota DOT published local guidance on slope stabilization and repair solutions to address the increased need for stabilization caused by intensified climatic events, and Texas is developing failure prediction and rehabilitation techniques for embankment slopes.

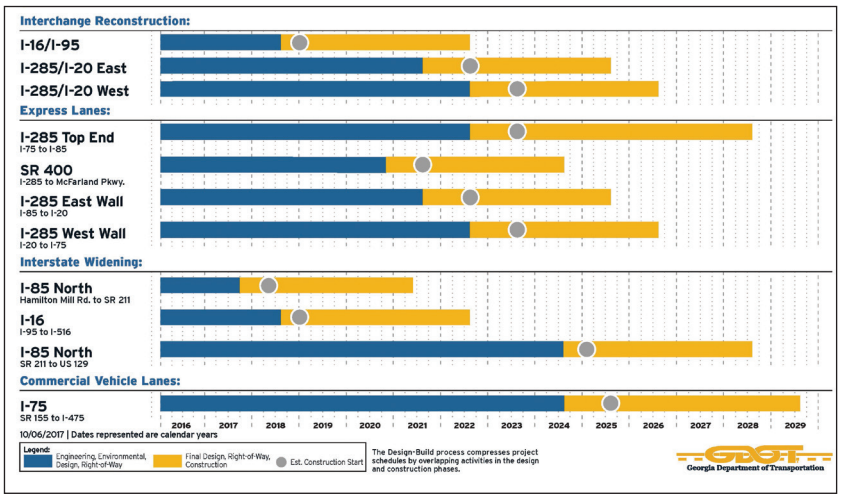
Photo: Utah DOT

Equipped with a lidar camera, this Utah DOT data-collection vehicle collects high-definition, 3-D representations of surrounding areas.

Advances in technology continue to benefit states. Kansas DOT is developing the use of 3-D subsurface modeling in road design to reduce costs, save time, and facilitate more-informed decisions. Several states are taking advantage of high-resolution remote sensing technologies—for example, lidar, photogrammetry, or GB-InSAR—not only for design and construction but also to help identify backslope instability. Combined with probabilistic tools, these technologies may lead to useful forecasting models.

Washington, Oregon, Ohio, and other states have implemented slope hazard rating and management systems, and states such as Alaska, Montana, Idaho, and Colorado are recognizing the advantages of developing an asset management program that includes geotechnical assets and hazards. Colorado DOT's program includes all earth-retaining structures, slopes, embankments, and roadway subgrades, and Montana DOT recently upgraded its rock slope assessment program. Identifying, quantifying, and communicating risk is a challenge.

Graphic: Georgia DOT



A timeline of Georgia DOT's Major Mobility Investment Program.

Sensors, GPS, and other onboard technologies have increased the efficiency of winter maintenance operations, optimizing plow routes and managing materials applied to icy roads.

Photo: Oregon DOT

Highway Maintenance and Preservation

Maintenance practices continue to take advantage of evolving technology. Since the mid-1990s, equipment operations and winter maintenance services have led the effort to incorporate technology. By equipping trucks with GPS, cellular technology, and other onboard sensors, several states have reduced costs and have increased the efficiency of winter maintenance operations.

Data-based decisions have helped several state transportation agencies optimize both their snowplow routes and the amount of materials applied to treat snow and ice on roadways.

In some far-flung locations, state DOTs use remote sensors to measure bridge deck temperatures to determine when the surface will freeze, thus necessitating closure of the bridge to traffic.

The development of automated vehicle technology—from assisted-driver systems to fully automated systems—is changing the way states consider infrastructure and services.

Photo: Chevrolet

Highway Operations

The development of CAVs again dominates the field of highway operations, commanding the attention of state DOTs across the country. So far, more than 40 states either have enacted legislation related to automated vehicles or are considering such legislation.

The development of these CAV technologies has progressed from research and development to advanced engineering. Automated vehicles are expected to be deployed in one form or another within one or two years.

Although fully self-driving cars are still three to seven years away, driver-assisted systems are available, along with vehicles equipped with sensors, cameras, and other safety devices. PricewaterhouseCoopers estimates that $230 billion is spent each year recovering losses caused by distracted driving; driver-assist technology could significantly reduce or end that loss.

It is too early to determine the exact form that transportation will take in a future of automated vehicles and technological advancements, but demonstration projects under way in many parts of the country incorporate CAV into cars, taxis, trucks, buses, highway maintenance vehicles, bicycles, and pedestrian facilities.

Some experts predict major land use changes in cities; for example, the need for parking reduced by the availability of automated vehicles and the development of mobility as a service. Public agencies are beginning to explore the impacts of CAVs on their infrastructure and services.

Safety

Another significant rise in motor vehicle–related fatalities occurred in 2016. According to the National Highway Traffic Safety Administration, the number of vehicle miles traveled (VMT) on U.S. roads increased by 2.2 percent, but the fatality rate per 100 million VMT increased by 2.6 percent from the previous year. Motorcyclist and pedestrian fatalities accounted for more than a third of the year-to-year increase. Driver error continues to be a factor in the vast majority of fatalities; infrastructure safety investment remains critical to eliminating and reducing the severity of motor vehicle crashes.

Kansas DOT is conducting research on the effects of speed limits on motor vehicle crashes and is examining details for categorizing pedestrian fatalities, such as when a crash involves a driver outside a broken-down vehicle. The organization of staff and programs to address emerging issues related to intelligent transportation systems is another focus for Kansas DOT.

The robust highway trust fund in New Jersey offers opportunities for the state DOT to implement a variety of programs. The agency emphasizes *Highway Safety Manual* methods for safety project selection and is working to advance safety projects on locally owned roads through outreach, peer exchanges, and technical support. Pedestrian and bicycle safety is a focus of the prioritization of complete-streets efforts in New Jersey as well.

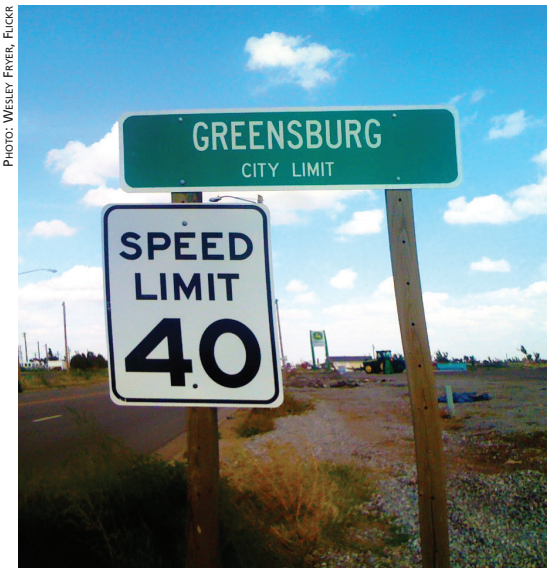


Photo: Wesley Fryer, Flickr

Speed limit sign in Greensburg, Kansas. Kansas DOT's research includes the effects of speed limits on crashes and better ways to categorize fatalities.

Photos: Dough Miller, Flickr (*left*); Steven Harrell, Flickr (*right*)

About 500 car crashes per year in Maine involve moose.

Did You Know?

◆ The Pennsylvania Turnpike was built partly on a railroad line that was begun but never completed—this includes some of the tunnels still in use today.

◆ Maine experiences about 500 moose crashes each year. The peak month for moose strikes is June.

◆ Three state DOT headquarters are not located in the state capital cities. Can you name them? (*Answer below.*)

◆ At 11,158 feet above sea level, the highest point on the Interstate Highway System is the Eisenhower Tunnel on I-70, 60 miles west of Denver, Colorado. The lowest point is on I-8 in El Centro, California, at 52 feet below sea level.

◆ The national average fuel mileage for tractor trailers has remained steady over the past 10 years at just under six miles per gallon.

◆ China surpassed Japan in 2009 as the largest producer of passenger cars. The top five producers of passenger cars in 2015 (in descending order) were China, Japan, Germany, the United States, and India.

◆ There were 701 recreational boating fatalities in the United States in 2016. That same year, all types of aviation in the United States recorded 412 fatalities.

◆ The 1.4 million miles of unpaved roads in the United States comprise about a third of the country's 4.2 million road miles.

Answer: Connecticut DOT in Newington, Iowa DOT in Ames, and Maryland DOT in Hanover.

Dedication and Perseverance

The 2017 State Partnership Visits Program revealed the hard work and dedication by state DOT staff members as well as their efforts to perform their duties under challenging circumstances, such as constrained budgets, extreme weather events, and rapidly changing technology. TRB hopes that the information exchanged in these visits can serve to help dedicated public servants perform their difficult jobs more easily and effectively.