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TR NEWS

School Transportation
Securing the Best Options

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TR NEWS

NUMBER 237 MARCH–APRIL 2005

SCHOOL TRANSPORTATION: SECURING THE BEST OPTIONS

3 INTRODUCTION
School Transportation: Improving the Safety, Security, and Quality of Student Travel
H. Douglas Robertson and Jeffrey C. Tsai

Established in 2004 as a forum for research and discussion addressing the complexity and diversity of school transportation issues, a TRB subcommittee is gaining participants and building a portfolio of papers and presentations.

4 ### Neighborhood Schools and Sidewalk Connections: What Are the Impacts on Travel Mode Choice and Vehicle Emissions?
Reid Ewing, Christopher V. Forinash, and William Schroeer

A study of the relationship between school location, the built environment around schools, student travel to school, and the emissions impacts of school travel yields findings that argue for neighborhood schools and improvements to sidewalk networks around schools. According to the study, centrally located schools to which students can walk or bike would reduce vehicle emissions significantly.

11 ### The Dynamics of School Location and School Transportation: Illustrated with the Dutch Town of Zwijndrecht
Enne de Boer

The structure of a school system, the location of schools, demographic shifts, consumer preferences, and ideas about traffic safety and security contribute to a changing dynamic, with quality and cost implications for school transportation. Case studies from a Dutch town offer insights into the interrelationships and the quest for workable solutions.

17 ### Automated Vehicle Location for School Buses: Can the Benefits Influence Choice of Mode for School Trips?
Tori D. Rhoulac

School buses equipped with automated vehicle location technology could allow central tracking, as well as advance notification of arrival at a stop. These benefits could prompt a 16 percent increase in parents' choice of the school bus instead of the automobile for travel to school by students in kindergarten through eighth grade, according to a study—with ramifications for safety, congestion, and more.

22 ### How Risky Is the Commute to School? Deaths and Injuries by Transportation Mode
Ann M. Dellinger and Laurie Beck

For children and youth 5 to 18 years old, the school commute is an important source of exposure to the traffic environment. The environment of school travel is changing—what corresponding changes, if any, have emerged over time in the rates of deaths and injuries related to school travel by transportation mode? Here are findings from a new study.

25 ### Child Passenger Safety Restraints in School Buses: Update on Regulations and Training
Susan Kirinich

4

17

35

COVER: School buses comprise the largest U.S. highway public transportation system. Researchers in a variety of disciplines, from land use and planning to high technology applications to public health and safety, are working to improve national and local school transportation policies.

TR NEWS

features articles on innovative and timely research and development activities in all modes of transportation. Brief news items of interest to the transportation community are also included, along with profiles of transportation professionals, meeting announcements, summaries of new publications, and news of Transportation Research Board activities.

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Javy Awan, Editor and Publications Director
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26 POINT OF VIEW
Addressing Security Risks in School Transportation
Pete Baxter, Charles Gauthier, and John Green
Many security professionals recognize that school buses are an easy target for terrorism. Three school transportation professionals outline practical steps to prevent—and, if necessary, be prepared to respond to—a terrorist attack on a school bus.

31 NEW TRB SPECIAL REPORT
Does the Built Environment Influence Physical Activity? Examining the Evidence
Nancy P. Humphrey
Empirical evidence links the built environment and physical activity, but few studies have proved capable of demonstrating a causal relationship. A joint study committee of the Transportation Research Board and the Institute of Medicine has recommended research strategies to gain practical guidance on cost-beneficial investments and changes in the built environment that would encourage increased levels of physical activity.

35 TRB 2005 ANNUAL MEETING HIGHLIGHTS
Providing a Safe, Secure, and Integrated System: 84th Annual Meeting Spotlights Transportation from the Customer's Perspective
An array of photographs and reports recaps some of the high-energy exchanges of information among more than 9,500 transportation researchers throughout the 2005 TRB Annual Meeting's paper and poster sessions, committee meetings, award recognitions, collegial exchanges, programs, exhibits, and more.

53 **Impressions of a First-Time Attendee**
John D. Bell

ALSO IN THIS ISSUE:

28 Research Pays Off
Reducing the Illegal Passing of School Buses: Video Footage Assists in Documentation, Training, and Raising Public Awareness
Jeffrey C. Tsai and Derek Graham

34 Calendar

55 News Briefs
Safer school bus stop and online resource for calming traffic

56 Profiles
Professor and transportation systems planning researcher Konstadinos G. Goulias and structural engineering consultant Mary Lou Ralls

58 Bookshelf

COMING NEXT ISSUE

Transportation security education and training is the theme of feature articles in the May–June *TR News*, including an assessment of programs and needs; the human factors and traffic engineering perspectives on evacuation planning; planning and training for emergency incident management operations; and the scope, content, and approaches of the security training programs at the National Transit Institute and the Indiana Department of Transportation.

INTRODUCTION

SCHOOL TRANSPORTATION

Improving the Safety, Security, and Quality of Student Travel

H. DOUGLAS ROBERTSON AND JEFFREY C. TSAI

School transportation involves complex issues. Every one of us is a user, a provider, or is affected by school transportation at some time during our daily travels. The 450,000 yellow school buses are the most visible and safest mode of school transportation and make up the largest form of public transportation in the nation.

Nevertheless many more students travel to and from school by personal vehicles operated by adults or teenagers than by school bus, contributing to traffic congestion and putting school-age children at greater risk. Teenage drivers represent the highest safety risk category. Public health professionals concerned about the sedentary lifestyle of school-age children are promoting travel to school by walking or bicycling to increase the levels of physical activity.

Smart growth advocates encourage thoughtful school sitings to avoid urban sprawl. At the same time, the nation's school systems face challenging academic performance standards that affect where students attend schools, and systems must cope with budget shortfalls that can force reductions in school bus services. In addition, the security exposure of school buses is a primary concern for school bus operators.

The Transportation Research Board's School Transportation Subcommittee, hosted by the Transportation Safety Management Committee, provides a focal point for discussing and debating these diverse issues, for identifying research needs, presenting results, and sharing strategies and solutions. The subcommittee was formed at the 2004 TRB Annual Meeting in Washington, D.C., to serve as a forum on issues, research, and programs affecting the safety, security, and quality of school travel.

Subcommittee membership has grown to nearly 50, including individuals from the Federal Highway Administration, the National Highway Traffic Safety Administration, the Environmental Protection Agency, the Centers for Disease Control and Prevention, the Federal Motor Carrier Safety Administration, the National Transportation Safety Board, state and city departments of transportation, state education agencies, universities, professional associations, and the private sector. Several members participated in the National Research Council study on school transportation safety, which produced TRB Special Report 269, *The Relative Risks of School Travel: A National Perspective and Guidance for Local Community Risk Assessment.*

The subcommittee's call for papers for the TRB Annual Meeting has sought submissions on the topics of school transportation and

- Safety and security;
- Children's health;
- Selection of modes;
- Air quality;
- The impact on roadways;
- The interactions with school planning and pupil assignments; and
- Intelligent transportation systems applications.

Many of these topics are discussed in the features and related articles assembled by the subcommittee for this issue of *TR News*. The subcommittee welcomes comments on the topics and invites participation.

The authors cochair the TRB School Transportation Subcommittee. Robertson is Director, Highway Safety Research Center, University of North Carolina, Chapel Hill, and Tsai is Program Director, Institute for Transportation Research and Education, North Carolina State University, Raleigh.

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Neighborhood Schools and Sidewalk Connections

What Are the Impacts on Travel Mode Choice and Vehicle Emissions?

REID EWING, CHRISTOPHER V. FORINASH, AND WILLIAM SCHROEER

Ewing is Associate and Research Professor at the National Center for Smart Growth Research and Education, University of Maryland, College Park. Forinash is Transportation Analyst with the Development, Community, and Environment Division of the U.S. Environmental Protection Agency, Washington, D.C. Schroeer is Vice President, ICF Consulting, Fairfax, Virginia.

In the next few decades, communities across the United States will have to accommodate substantial increases in student enrollment. The expected boom in school construction and renovation and the related planning decisions have implications for travel and for vehicle emissions.

The study reported here was the first to examine the relationship between school location, the built environment around schools, student travel to school, and the emissions impacts of this travel. Students with shorter walk and bike times to school proved significantly more likely to walk or bike—which argues for neighborhood schools. Students who have access to sidewalks along main roads were also more likely to walk—which argues for improvements in sidewalk networks.

Neighborhood schools that can be reached by walking and biking can increase the amount of walking and biking to school, can shorten trip distances, and can reduce motor vehicle emissions significantly.

PHOTO: DAN BURDEN, WALKABLE COMMUNITIES, INC.

Size and Location Trends

Public schools have been increasing in size and drawing students from larger areas. Between 1940 and 1990, the total number of elementary and secondary public schools fell by 69 percent, despite a 70 percent increase in the U.S. population (*1*). Large new schools typically are placed in outlying areas, because sites are available and land prices are low.

Public policies have contributed to this trend (*2–4*). The funding formulas in many states favor new school construction over renovation. Minimum acreage standards for elementary, middle, and high schools may be met only at greenfield locations. Building codes designed for new construction are applied to older schools that could be renovated. School districts are often exempt from local planning and zoning laws and can site schools without consideration of local policies and plans.

Walking and Biking Trends

Paralleling the trend toward large schools at remote sites is the sharp decline in walking and biking to school. According to the recently released 2001 National Household Travel Survey, less than 15 percent of students between the ages of 5 and 15 walk to or from school, and only 1 percent bike. In 1969, the first Nationwide Personal Transportation Survey (NPTS) showed that 48 percent of students walked or biked to school (*5*).[1]

A recent survey by the Centers for Disease Control and Prevention (CDC) found that only 31 percent of children 5 to 15 years old who lived within 1 mile of school walked or biked (*6*). In 1969, the figure approached 90 percent (*5*).

Why the decline in walking and biking to school? In the CDC survey, parents cited long distances as the primary barrier (6). The supersizing of schools has left relatively few students living within comfortable walk-

[1] This figure applies to students in elementary and intermediate grades, the closest counterparts to the 5–15 age range reported for 2001.

ing or biking distance. Nonetheless, even short school trips are made by automobile, which indicates that other factors are at work.

The CDC survey found that danger from traffic was the second most important barrier to walking and biking to school (*6*). The absence of sidewalks is a risk factor for pedestrian accidents (*7-8*). A poor walking environment has been linked to dependence on the automobile by the general population and would be expected to discourage walking and biking to school (*9*).

Childhood Health Trends

Accompanying the decline in school walk and bike trips has been a general decline in physical activity and a rise in childhood obesity. National data indicate that nearly one-third of all American youth do not engage in sufficient amounts of vigorous or moderate physical activity (*10*).

In 1999–2000, 15 percent of U.S. children 6 to 11 years old and 16 percent of adolescents 12 to 19 years old were overweight. Since the 1960s, this statistic has nearly tripled for adolescents and quadrupled for 6- to 11-year-olds (*11*).

Walking and Biking

In response, many states and localities have launched Safe Routes to School programs[2]—California has led the way. The programs provide funding for sidewalks, bike lanes, and other infrastructure improvements to encourage walking and biking by schoolchildren. The U.S. Department of Health and Human Services and CDC have started a Kids-Walk-to-School Campaign, to counter the rising rates of childhood obesity, diabetes, and asthma.[3]

[2] www.dhs.ca.gov/epic/sr2s/

[3] www.cdc.gov/nccdphp/dnpa/kidswalk/

Photo: Dan Burden, Walkable Communities, Inc.

Photo: Dan Burden, Walkable Communities, Inc.

Neighborhood Schools

Policy makers are reemphasizing the value of small, in-neighborhood schools. New investments are coming from federal, state, and local governments, as well as from foundations focused on educational performance.

In fiscal year (FY) 2002, Congress appropriated $142 million for the Smaller Learning Communities program, up from $44 million in FY 2000, to help large high schools and school districts make schools smaller. The Bill and Melinda Gates Foundation has invested $1 billion over 5 years to create 1,500 new small high schools.

In July 2003, South Carolina eliminated its minimum acreage requirements for schools and granted waivers for school square footage to foster neighborhood schools. The Council of Educational Facilities Planners International has removed the high minimum-acreage requirements from its industry-standard school-siting guidelines (*12*).

Across the country, cities and school districts offer other compelling examples. In Milwaukee, the Neighborhood School Initiative is constructing six new schools, adding on to 19 schools, and renovating 15 schools. All schools remain in walkable neighborhoods, and more students can attend school in their own neighborhood.

In St. Paul, Minnesota, the newly renovated and expanded John A. Johnson Achievement Plus Elementary School is a compact, multistory building that allowed an increase in the number of playing fields. Additional buildings are planned to accommodate future student increases.

Wake County schools partnered with the City of Raleigh, North Carolina, to build the Moore Square Museums Magnet

Middle School on a four-acre block in an in-town neighborhood. The school won a National Award for Smart Growth Achievement from the U.S. Environmental Protection Agency (EPA) in 2003 and has drawn new residents and investments to its neighborhood.

Neighborhood School Advantages

Small neighborhood schools are said to

- Foster a better learning environment with higher student achievement,
- Promote neighborhood cohesion and pride,
- Discourage sprawl and preserve farmland,
- Lower busing costs and student parking requirements, and
- Encourage children to walk or bike to school (*2–4*, *13–14*).

School Mode Choice

Research that connects mode choice for the journey to school with characteristics of the built environment is sparse. The studies collectively suggest that children are more likely to walk or bike to small schools in walkable neighborhoods than to large schools in remote locations.

In one study, the percentage of students walking to school was found to be four times higher for schools built before 1983 than for those built later—an average of 16 percent walked to older schools compared with 4 percent to newer schools (*2*). A study of fifth-grade students at 34 California public schools showed that walking and biking rates were associated positively with neighborhood population density and negatively with school size, after controlling for the percentage of students on public welfare and for the percentage of ethnic minorities (*15*).

A study of school mode choice in California found that walking and biking to school were more likely for a household living within 1 mile of the school (*16*), and less likely for a household with licensed drivers who could provide rides. Some pedestrian-friendly design features had positive influences on walking and biking, such as the presence of street trees within one-quarter mile of the school. Other features, such as short blocks and mixed land uses, had negative influences.

TABLE 1 Travel Modes for School Trips from Gainesville Surveys, Kindergarten Through 12th Grade

Mode	Count
Car	548
School Bus	105
Walk	32
Bike	24
Total	709

Model Development

Travel demand modeling attempts to explain mode choice as a function of characteristics of trip origins and destinations, trip interchanges, and travelers. The literature suggests that mode choice for school trips also may depend on school location and accessibility, school size, and grade level.

The utility function in a school mode choice model, therefore, should include characteristics of trips, students, schools, and built environments at each end of the trip. Alternative multinomial and nested logit structures were estimated using maximum likelihood techniques.

Gainesville, Florida, was chosen as the study area. Two regional surveys including travel diaries offered a relatively large sample of trips to analyze. Moreover, many variables characterizing the built environment could be examined for their influence on mode choice.

The variables describing urban form were available at the traffic analysis zone level. The variables included overall density, the balance of jobs and residents, the job mix, the commercial floor area ratio, sidewalk coverage, bike lane and paved shoulder coverage, street tree coverage, and two regional accessibility measures (*17*). Table 1 reports mode of travel for the final sample of 709 school trips. Figures 1 and 2 illustrate the locations and the built environments of two Gainesville high schools with contrasting mode splits.

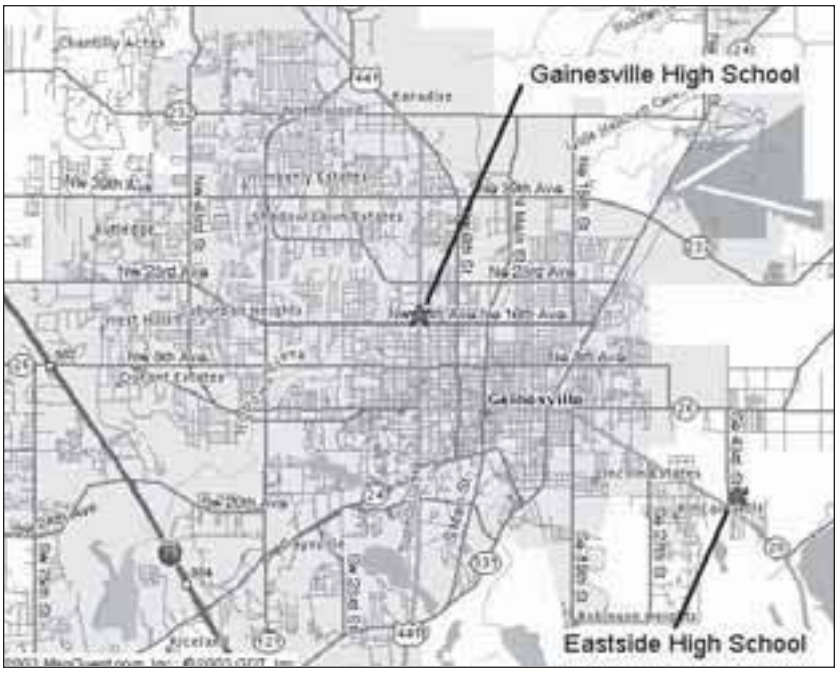
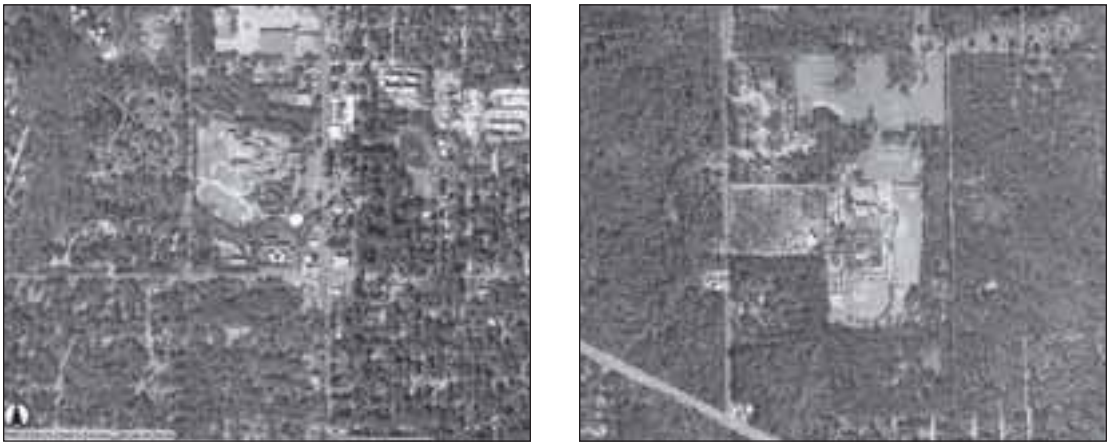


FIGURE 1 Location of sampled schools: Gainesville High School and Eastside High School.



(a) (b)

FIGURE 2 Aerial views of the sampled high schools (same scale), with data for sampled trips: (*a*) Gainesville High School: auto trips 38 (85%); walk trips 6 (13%); bike trips 1 (2%); average auto trip length: 4.24 miles; and (*b*) Eastside High School: auto trips 19 (100%); average auto trip length: 8.42 miles.

Model Results

The best-fit model is presented in Tables 2, 3, and 4. In Table 2, coefficient values and *t*-statistics indicate the effects of independent variables on mode choice probabilities.

In Table 3, the marginal effects of independent variables on mode choice probabilities are presented as elasticities. Elasticities summarize the relationships between travel outcomes and the explanatory variables. The values presented are point elasticities at the mean values of the independent variables.

Table 4 presents the results of simulations that lowered the values of each independent variable by 25 percent and computed new choice probabilities. The mode shares were computed by summing the probabilities and multiplying by the number of individuals. The difference between the original mode shares and the simulated mode shares represents the effect of changes in the variable on the aggregate behavior of the sample.

Emissions Impacts

Travel behavior has important impacts on environmental quality, especially on emissions and air quality.

TABLE 2 Multinomial Logit Model Parameters for School Bus, Walk, and Bike Modes, with Automobile as Base Mode

	Bus		Walk		Bike	
Variable	Coeff.	*t*-stat.	Coeff.	*t*-stat.	Coeff.	*t*-stat.
Constant	-1.054	-6.44	2.385	2.40	-1.301	-3.87
Annual household income (in thousand dollars)			-0.0334	-3.33		
Per capita auto ownership for the household			-4.570	-3.61		
License ownership indicator (1 if the individual holds a drivers license, 0 otherwise)	-2.513	-4.23				
Walk time for the trip (in minutes)			-0.0527	-3.98		
Bike time for the trip (in minutes)					-0.1504	-4.07
Average sidewalk coverage for origin and destination zones			1.480	2.09		
Average home-based other accessibilities for origin and destination zones	-1.130	-2.37				

Restricted log-likelihood	-982.9
Log-likelihood with constants only	-493.9
Log-likelihood at convergence	-425.4
Pseudo-R^2	0.139
Number of observations	709

TABLE 3 Point Elasticity Estimates from the Multinomial Logit Model

Variable	Bus	Walk	Bike
Annual household income (in thousand dollars)		-0.84	
Per capita auto ownership for the household		-1.16	
License ownership indicator (1 if the individual holds a drivers license, 0 otherwise)	-0.91		
Walk time for the trip (in minutes)		-0.66	
Bike time for the trip (in minutes)			-2.63
Average sidewalk coverage for origin and destination zones		0.42	
Average home-based other accessibilities for origin and destination zones	-0.31		

Therefore, as a final step, the vehicle emissions impacts were estimated for different school locations and built environments.

To illustrate the emissions impacts of school location and the built environment, emissions were estimated for two schools from the Gainesville sample. The preferred choice model then simulated the travel and emissions differences between the Gainesville sample and an alternative of neighborhood schools with complete sidewalk networks.

High Schools Comparison

Gainesville High School is centrally located and surrounded by development; Eastside High School is located at the edge of an urbanized area amid undeveloped land. The mode split at Gainesville High School is 85 percent automobile, 13 percent walking, and 2 percent biking. Eastside High School had 100 percent automobile use. Gainesville High School students who drove had an average trip about half as long as that of Eastside students.

Vehicle emissions were estimated for each school; Table 5 presents the results. Although the samples were small, the following observations can be made:

- Longer automobile trips and higher automobile mode shares contributed to emissions that were more than twice as high for sampled Eastside students as for their Gainesville counterparts, and
- The longer average trip for Eastside students—twice that of Gainesville students—contributed more to the higher emissions than did the higher automobile mode split.

Neighborhood Schools Simulation

The best-fit model was applied to simulate mode choice probabilities for a scenario with neighborhood-based schools and complete sidewalk networks. Results were compared with the actual mode choices for the Gainesville sample.

In the scenario, neighborhood schools allowed for a 10-minute walk and a 2.5-minute bike ride—travel times for a distance of 0.5 miles at 3 mph and 12 mph, respectively. All arterials and collectors were assumed to have sidewalks. All other variables were held constant.

TABLE 4 Base Mode Share and Simulated Mode Share with a 25 Percent Change in Each Independent Variable

Variable	Change	Car	Bus	Walk	Bike
Base mode share	—	77.3	14.8	4.5	3.4
Annual household income (in thousand dollars)	-25%	76.2	14.6	5.9	3.2
Per capita auto ownership for the household	-25%	75.8	14.5	6.5	3.2
Walk time for the trip (in minutes)	-25%	76.5	14.7	5.5	3.3
Bike time for the trip (in minutes)	-25%	76.5	14.7	4.5	4.4
Average sidewalk coverage for origin and destination zones	-25%	77.9	14.9	3.7	3.5
Average home-based other trips for origin and destination zones	-25%	76.5	15.7	4.5	3.4

Values may not total 100 percent because of rounding.

TABLE 5 Emissions for Travel to or from Two High Schools

	Mode		Trip Length	Emissions/day, grams			
	Auto	Nonauto	Average Auto, mi.	VOC	CO	NO_x	CO_2
Gainesville	85%	15%	4.24	15,472	191,931	12,894	5,936,186
Eastside	100%		8.42	36,147	448,408	30,123	13,868,670
Eastside/ Gainesville	1.18		1.98	2.34	2.34	2.34	2.34

VOC = volatile organic compounds; CO = carbon monoxide; NO_x = oxides of nitrogen; CO_2 = carbon dioxide

TABLE 6 Base Mode Shares, Simulated Mode Shares, and Mode Share Changes with a Neighborhood Schools Scenario

Variable	Base	Simulation	Simulation/ base
Car	77.3%	66.0%	85%
School Bus	14.8%	12.7%	86%
Walk	4.5%	10.3%	229%
Bike	3.4%	11.1%	326%

Values may not total 100 percent because of rounding.

PHOTO: DAN BURDEN, WALKABLE COMMUNITIES, INC.

The reductions in walk and bike times and the increase in sidewalk coverage caused a significant shift in mode shares (Table 6). The percentage of students walking to school more than doubled, from 4.5 to 10.3 percent of all trips. The percentage of students biking to school almost tripled, from 3.4 to 11.1 percent. Together, the nonmotorized mode share increased from 7.9 to 21.4 percent.

The results are consistent with the earlier simulations. Gainesville students' travel preferences show that they would bike and walk in substantial numbers if the distances were kept short enough.

The emissions impacts of such a shift were estimated from national values for school bus average trip length (6.8 miles, according to the 1995 NPTS) and student loads (25 per bus). National averages from U.S. EPA's mobile source emission model, MOBILE 6, yielded estimates for school bus emissions. Automobile trip distances were set at the Gainesville sample average, 4.82 miles. Finally, an enrollment of 400 was assumed for the neighborhood school, although the assumption made no difference in the relative results.

The simulated neighborhood schools reduced emissions by 14 to 15 percent. The reductions were not uniform because of the different emissions profiles of school buses and personal vehicles (see Table 7). This simulation probably underestimated the change in emissions by assuming fixed distances for automobile and school bus trips.

Implications of Findings

In this study, students with shorter walk and bike times to school proved to be more likely to walk or bike. If confirmed through subsequent research, this finding argues for neighborhood schools that serve nearby residential areas.

Students traveling through areas with sidewalks on the main roads also were more likely to walk. If confirmed, this finding argues for Safe Routes to School sidewalk improvements.

The study also determined that centrally located schools to which students can walk or bike would reduce vehicle emissions significantly. If confirmed, this finding adds one more rationale for small neighborhood schools over megaschools on large outlying sites.

The findings are only partly consistent with earlier studies of school mode choice. Two previous studies found distance from home to school to be significant, a result confirmed by this study. Elements of the built environment around a school also were found to be significant, as in this study.

The characteristics of the built environment that influence school mode choice, however, remain an issue. Neighborhood population density proved important in one earlier study; street tree coverage in the vicinity of a school was important in another study; and age of schools—which can be related to traditional neighborhood design, higher density, and finer land use mix—was important in a third study. None of these variables proved significant in this study, which indicated instead that sidewalk coverage was

TABLE 7 Emissions Levels for Base Case and Neighborhood Schools Simulation

	Emissions/day, grams			
	VOC	CO	NO_x	CO_2
Sample mean	3,907	43,202	13,043	2,599,545
Simulation	3,338	36,894	11,180	2,225,186
Simulation/Sample mean	0.85	0.85	0.86	0.86

Photo: Dan Burden, Walkable Communities, Inc.

significant—a result not previously documented.

The role of school size in travel mode decisions also requires further study. Student enrollment proved significant in one earlier study of mode choice, but not in this study, which included controls for travel time to school. Whether school size has a direct effect on school mode choice, beyond the indirect effect on travel time to school, therefore, remains an issue.

The implications of these and similar results for planning practice are clear. School siting decisions are among the most important and expensive investments that communities make. The decisions have an impact not only on core educational goals, but also on issues of community growth and development, urban form, and public health.

The study results indicate that large schools on remote sites may have the same negative travel and emissions consequences as other more generally recognized forms of sprawl. Planners may want to work with educational policy makers to discourage this practice.

Acknowledgments

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The Dynamics of School Location and School Transportation

Illustrated with the Dutch Town of Zwijndrecht

ENNE DE BOER

The author is Associate Professor, Transport and Planning, Faculty of Civil Engineering and Geosciences, Delft University of Technology, Netherlands.

The yellow bus is the icon of school transportation. Traveling to school, however, is a complex undertaking, not always defined by icons—school systems have many levels, corresponding to the ages of the students, and the ages of the students, in turn, correlate with different means of transport.

The interrelationship is not static. The school system may change, along with the spatial distribution of schools, which may change as a result of aging structures, demographic shifts, or even consumer preferences. Ideas about transport, traffic, safety, and security also may change.

The Dutch town of Zwijndrecht illustrates these remarkable dynamics. Dutch school transportation is not representative of the European Union. The member states differ in education policies and in school-related transport policies.

For example, in the 1970s, Germany enlarged its schools, not realizing that the necessary bus transport would cost billions of marks per year. As a result, Germany later left smaller schools alone and built cycleways to restrict the volume of bus transport, which it transformed largely into public transport.

Changes in School Transport in The Netherlands Since 1985

- Economizing on public transport.
- Economizing on school transport.
- Raising standards for school transport quality.
- Decreasing access to school transport.
- Increasing local car mileage by 75 percent.
- Expanding cycling facilities for shorter and longer distances.
- Introducing "sustainable safety" policies.

In contrast, Belgium historically has favored larger schools and has a vast school transport system. Belgium, however, hesitates to promote cycling because of the high accident rates.

School System and Transport

The Dutch school system has three main levels:

- Primary or basic—5 to 12 years old;
- Secondary or midlevel education—12 to 18 years old; and
- Tertiary or higher education—18 to 24 years old.

Students at the higher education level can travel independently—most have a driver's license and move to the town where the school is located.

There are two types of primary schools:

- The basic school, which serves small settlements, so that walking and cycling—independently or under guidance—become the dominant transport modes; and
- The special basic school, which serves children with learning and behavioral problems; these schools are located in moderately sized regional centers and require organized transportation, especially for rural areas.

Children with other types of problems attend specialized schools organized in clusters and available only in larger regional centers. These require organized and sometimes specialized transport.

Secondary education has a more complex structure, with different levels, sublevels, and curricula. The primary distinctions are

- General education, in a grammar school or Gymnasium—which teaches classical languages—

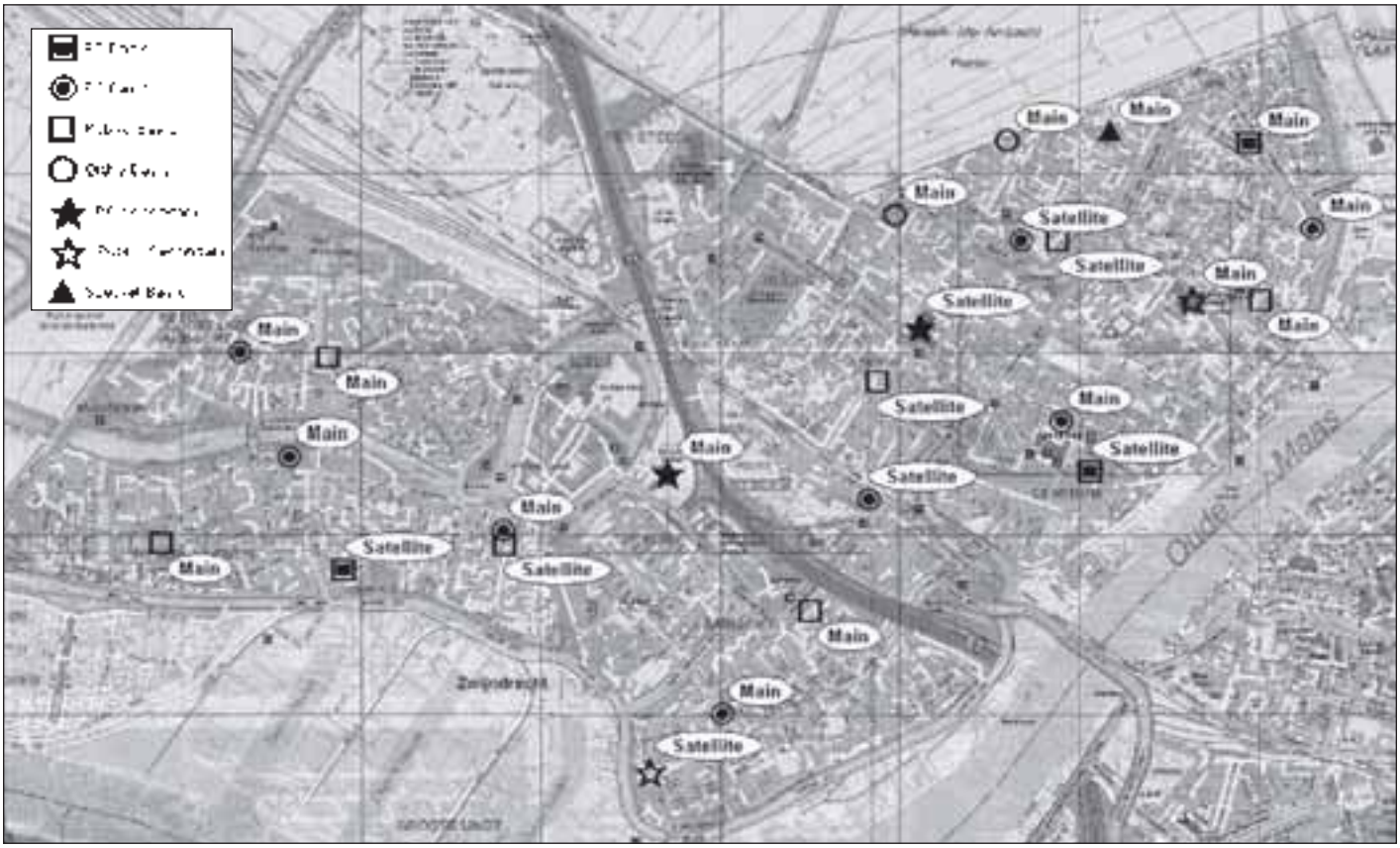

FIGURE 1 Locations of schools in Zwijndrecht. (RC = Roman Catholic; PC = Protestant Christian; Ortho = Orthodox Protestant.)

preparing students for higher education and for university.

- Vocational or practical professional education at two successive levels: preparatory and senior secondary.

The common types of secondary education are available in modestly sized regional centers; Gymnasia are located in larger centers; and special types of vocational education—for example, in shipbuilding and forestry—are offered only in a few locations.

Students mainly rely on cycling; at the age of 16 years, some switch to mopeds. Less than 30 percent of students use public transport. In larger rural areas, however, education is the most important motive for travel by public transport. Separately organized school transport is rare, occurring mostly in rural locations that are trying to attract students from urban areas.

Dynamics of Zwijndrecht

Zwijndrecht is a town of 43,000 in southeastern Randstad Holland, a circular zone of urbanization that includes the nation's capital of Amsterdam, the government center of The Hague, and the port of Rotterdam. In Zwijndrecht, the dynamics of primary and secondary education—even without senior secondary-level vocational schools—makes the prediction and solution of transport problems a challenge (see map, above).

Zwijndrecht is the largest of the suburbs of the ancient town of Dordrecht, southeast of Rotterdam, on an island between branches of the Rhine. The conurbation, called Drechtsteden, or Drecht towns, includes 250,000 inhabitants.

Zwijndrecht was developed largely after World War II. The city area borders a remarkable international infrastructure: the main shipway to Germany; the main highway to Belgium; and the four-track rail line to Belgium and southeast Holland. Under construction are a cargo rail line to Germany and the High-Speed Link South, connecting to France's passenger network. This development has created several barriers between the older north side of the town and the south side.

Secondary Schools

The town has two competing institutions for general secondary education and preparatory vocational education: Develstein College and Walburg College. Both are named for small castles that once stood on the then-separate Zwijndrecht Island.

Develstein offers Protestant education. Walburg is nonreligious. The schools have administrative boards—

The special education unit of Walburg College, in the building of a former primary school.

a foundation and a public body, respectively. Both are financed by government, with the cost of education borne by the national Ministry of Education.

The schools offer slightly different types of education. Develstein offers no Gymnasium education, although the school recently applied for government financing to do so. Walburg offers no technical preparatory vocational education. Both schools have several locations, some in neighboring towns.

Develstein College has a total of 1,530 students, with 1,040 enrolled at the main campus, south of the highway, in the highest levels of general education, including preparatory vocational education. A former technical school in the northern part of the town houses lower levels of theoretical and practical prevocational education. A satellite school in the neighboring town of Hendrik-Ido-Ambacht, with about 30,000 inhabitants, offers lower levels of prevocational education to local students.

Walburg College, with a total of 2,200 students, serves 1,000 students at the main campus, north of the highway in the new town center. Only a high level of general education is provided at this facility. The building needs an extension.

A settlement in the town of Barendrecht supplies similar education to 635 students, and two settlements in Hendrik-Ido-Ambacht provide the lower levels of prevocational education. A former primary school in Zwijndrecht houses the lowest level of the program (see photograph, above).

Despite the integration of the different kinds of secondary education into single institutions, geographic integration is lacking. Walburg College has separated the lower layers from what might be called its core program of general pre-university education.

The municipality of Zwijndrecht has developed a plan, working with the two local colleges, to reduce the number of school locations by moving students from the three locations in Hendrik-Ido-Ambacht to Zwijndrecht for practical preparatory vocational education. Both colleges then would share a local education center. Neighborhood residents, however, protested the expansion to 1,050 students.

Transport Consequences

The transport consequences of integrating the schools into larger units did not receive consideration. The planned physical relocation is unlikely to cause changes in travel mode choice. Students cycle for distances up to 5 kilometers year round (*1*), and the school journey is unlikely to exceed that distance. Moreover, public transport is insufficient and therefore is not an attractive alternative.

Traffic safety is a concern, however, because the daily cycle mileage for local secondary education—already a massive 2,500 round trips—would increase by about 10 percent. The 12- and 13-year-old cyclists are vulnerable because of inexperience in heavy traffic. The lengthened cycling distances would take a toll in accidents.

Cycling Measures

The Dutch national traffic policy strives for "sustainable safety," creating conditions that counter the risk of crashes. In urban areas, traffic zones are distinguished from "traffic calming zones." In traffic zones, motorized traffic is separated from other traffic and may travel at 50 kilometers per hour (km/h); in traffic calming zones, the speed limit is 30 km/h.

Zwijndrecht has separate cycling facilities along its main arteries (see photograph, below). In converting to the sustainable safety system, the municipality separated the two car lanes on Queens Road, the old town axis, and reduced traffic on Walburg Avenue, which continues to the Hendrik-Ido-Ambacht border, from four to two lanes.

Some intersections were cut off; others were provided with miniroundabouts, slowing cars to less than 50 km/h. Surrounding neighborhoods, which have mostly grid-like street layouts, were designated as 30-km/h zones. The general introduction of the principle may take more than a decade.

New cycle lanes and a pedestrian crossing at Steenen Kamer school.

Father and daughter leaving the new Volgerlanden school complex via Welhorst Avenue racing course; the cycle path is closed.

The separate cycle facilities along the roads were expanded to serve the routes to the colleges. Students from Hendrik-Ido-Ambacht will be able to reach the Zwijndrecht local education center almost completely on the separate cycle facilities; some intersections, however, remain dangerous.

The Zwijndrecht transport plan emphasizes cycle traffic (see photograph, above). Separate cycle facilities will be expanded, especially for routes to Barendrecht and the small town of Heerjansdam. School itineraries will receive special attention.

Traffic rules are not taught systematically in school, and misdemeanors such as cycling on sidewalks or traveling in the wrong direction on roundabouts occur frequently. On early winter mornings, police often fine students who have cycled between Hendrik-Ido-Ambacht and Zwijndrecht without the required headlamps or lighting. Police regularly inspect the safety condition of bicycles at the school gates.

Every September, the national traffic safety organization 3VO launches a nationwide campaign with the slogan, "We are going to school again," to alert automobile drivers to the return of schoolchildren on cycles.

Special Education

The one school for special basic education in the town, Steenen Kamer (which means "stone chamber"), is a nonreligious school administered by a foundation that operates two other schools in the Dordrecht suburbs. The school recently extended its scope to include children with learning disabilities, in cooperation with the primary schools in the area. The school building was expanded from 6 to 9 classrooms, and further expansion to 13 classrooms is foreseen.

The transport implications are modest. The influx from the school's area in Zwijndrecht and Hendrik-Ido-Ambacht has increased. The exchange of pupils with schools in Sliedrecht and Papendrecht, across the River Noord, has introduced commutes of 15 kilometers and more.

Distances and Costs

A pupil's home municipality is responsible for providing organized transport to school. Until recently, children under 10 years old were entitled to support for the journey to a religious school of choice that is farther than 4 kilometers away on "the shortest passable road"—the equivalent of an hour's walk. For students who require special education, the minimum distance to qualify for travel support was 2 kilometers.

These standard distances, however, have been raised to 6 kilometers because of costs. Many parents may have difficulty bringing their children to school over such distances. Zwijndrecht, however, decided to retain the 2 kilometers standard for students in special education; the 6 kilometers standard for other schools went into effect without consequences.

The municipality must assign an appropriate type of transport, after consulting with each school. Public transport is preferred for children who are mentally and physically able to use it; if necessary, parents should accompany the children. If the journey by public transport takes more than 1½ hours, and if the commute can be reduced to less than half the time, special transport must be provided. These rules are strict, but if special transport must be provided for one or two children, municipalities will assign the remaining seats to other students.

The bulk of the cost (€600,000 annually) is for transport to the more specialized schools in larger towns. Municipalities often cooperate in organizing this transport, usually under contracts awarded after competitive bidding. The contracts, however, make few stipulations about quality and safety.

Transport Volume

The volume of transport often precludes the use of large buses, which would take too much time to collect a full load. Most special transport is provided by minibuses and taxis, which pick the children up at home. Steenen Kamer has parking spaces reserved for the small school vehicles.

Previously, only children 10 years old and up had to be provided with a seat. In this way, three children between 4 and 10 years old could be seated on two seats, and those under 4 years old did not need a seat—they could sit in a lap.

Complaints about this arrangement were many: for example, children could roam around the vehicles, sit on the floor, or even open the doors while the vehicle was in motion. Since January 2004, each child must be provided with a seat and a seatbelt, which must be fastened during the ride. This has increased the cost of transport considerably, leading to the 6 kilometers standard.

A national project to establish municipal advisory councils for pupil transport started in 2003. Including representatives of the parents and supported by orga-

nizations for the disabled and for traffic safety, the councils channel complaints and promote general quality. Funds were not available, however, for developing a quality instrument or measure, which remains on the agenda.

Primary Education

The freedom of education is a remarkable tradition in Holland. The coexistence of religious and nonreligious schools is a result of the "Pacification of the Schools Struggle" in 1917, which gave religious schools the same rights as public municipal schools.

Zwijndrecht includes four public, one Catholic, six Protestant, and two orthodox Protestant schools. The town has more school locations than schools. In successively developed town quarters, schools were located according to the number of children and were spread more or less evenly but seldom accommodated more than 200 pupils.

In most neighborhoods, after one or two decades, the population ages, and the number of children declines. Schools can fall below the subsistence level, particularly when standards for a minimum school population are raised (2).

In the early 1990s, the Ministry of Education raised minimum enrollment for Zwijndrecht schools to 177 students. Several schools were too small to continue. Amalgamation with a school in another neighbourhood, however, could preserve local education, creating a single school with more than one location. In Zwijndrecht, for example, the Catholic Toermalijn School has its main campus in the Walburg II quarter and a satellite in the village of Juliana. The locations are far apart, and these are the only schools in each quarter.

The municipality's integrated school plan for 2004 anticipated a shortage of classrooms in some schools, but vacant classrooms in others. The municipality therefore may recommend moving schools or parts of schools. The standard maximum distance for relocation is 2 kilometers.

Picking up children at the new Volgerlanden school complex; in bad weather, car use increases.

School Facilities

Municipal responsibility for cost-effectiveness stimulates the concentration of schools into one building, as well as the agglomeration of schools into shared facilities. Another trend is the development of schools by different institutions, to offer day care for preschoolers and after-school facilities for children who cannot go home before 5 or 6 p.m.

Two noteworthy examples are the recently opened Roerdomp facility and the Volgerlanden school. At Roerdomp, a Protestant primary school was expanded to house a satellite of a public school, a day care center for retarded children, and an institution for handicapped pupils.

Volgerlanden is a developing residential area, with 4,500 homes in about 2 square kilometers, filling the gap between the urbanized areas of Hendrik-Ido-Ambacht and Zwijndrecht. Only one school is planned, with 44 classrooms in four semidetached buildings: two primary schools and two satellites of other schools. A fifth building will house additional services. Some of the buildings will be convertible into dwellings when pupil numbers decline.

Mode Choice

The traditional spatial distribution of schools for primary education had made walking the dominant mode

Margriet primary school, located at a roundabout with a highway access road.

Disconnected neighborhood access road near Margriet primary school.

Small-scale long-distance school transport at the Liberated Reformed school.

of school travel. This is still the case for most schools.

Biking is relatively modest, in part because schools that have insufficient space for bicycle storage discourage cycle use for distances less than 500 meters. The intent is to stimulate walking, but the policy instead may stimulate automobile use. Cycling at the orthodox Protestant schools, however, reaches levels of 50 percent, because students come from longer distances.

Schools in residential areas have no special parking facilities, and even modest levels of car use may cause chaos and raise safety risks near the school. New schools, like those in the Volgerlanden area, register higher levels of car use—up to 50 percent—partly because of longer travel distances . The parking lot at Volgerlanden (see photograph, page 15), with a capacity of about 30, is not sufficient, although a local shopping mall nearby offers ample parking space.

Travel to the nearest school may require many children to cross main arteries—for example, if the school is located on the other side of the road. The Margriet location of Juliana school is in a commercial area on a roundabout with a highway access road as one exit (see photographs, page 15). Because crossing is unavoidable, a conspicuous crosswalk on the main artery should maximize visibility for car drivers; in addition, the school can assign crossing guards.

Transport Measures

These circumstances make organized school transport rare, except for orthodox religious schools. The Liberated Reformed school draws students from the largest area, using several types of vehicles, including two touring cars, to bring 80 pupils from the province of North Brabant, about 25 kilometers away (see photograph, left).

Traffic safety receives great attention, because 38 percent of crashes involving children occur on the journey to and from school. The trip to school is a classroom subject, concluding with a traffic exam. In addition, student itineraries are analyzed with support of the national traffic safety organization, and parent volunteers are trained to spot and solve traffic problems near the school.

Zwijndrecht has created special pedestrian crossings for school itineraries. The normal configuration is a zebra-striped crosswalk marking, a middle island to enable crossing in two phases, and a conspicuous warning sign. School entrances are fenced to prevent students from running out onto the street. In some cases, traffic wardens provide surveillance.

Practical Solutions

Administrative, financial, and institutional changes, as well as changes in consumer behavior, have an impact on population concentrations, school location policies, and school travel and transportation. Creating a range of educational choices at a single location raises the disadvantages of long journeys and of large concentrations of students.

The study of school transportation must master this confusing universe and indicate the quality and cost implications of location and transport decisions. The study of school transportation should produce practical solutions.

The province of South Holland wanted to quantify the concept of "reasonable distance" for school travel, cited in the secondary education law. The province favored a distance of 15 kilometers—that is, 1 hour by bicycle. Research, however, suggested a standard that was the product of minimum school size—then 240 students for a 4-year curriculum—and a maximum travel time of 60 minutes for a single trip as the travel time budget. Schools that exceed this budget, according to the findings, should consider new locations or faster transport (*3*).

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Automated Vehicle Location for School Buses

Can the Benefits Influence Choice of Mode for School Trips?

TORI D. RHOULAC

The author is Assistant Professor, Department of Civil Engineering, Howard University, Washington, D.C.

School-related traffic congestion is a problem in many communities. Nearly 60 percent of all school trips are made in personal automobiles and only 25 percent in school buses (*1*), although the National Highway Traffic Safety Administration (NHTSA) has described the school bus as "the safest form of transportation for children" (*2*).

With the goal of enhancing student safety and reducing school-related traffic problems, research was conducted between 2000 and 2003 into the household attributes and behaviors that influence school transportation mode choice. The research looked to identify problems and prioritize solutions for increasing the attractiveness of school bus service, including improvements available through automated vehicle location (AVL) technologies.

One objective was to determine the impact that AVL could have in prompting a shift to the school bus from the private automobile. The focus was on students who had to travel by a motorized mode because of the distance from home to school.

The study findings indicate that the application of AVL technologies to school buses can prompt a shift from the personal automobile for students in kindergarten through eighth grade. The addition of AVL tracking and traveler information technologies could produce a modal shift of 16 percent from automobile to the school bus.

AVL for School Buses

For nearly 15 years, intelligent transportation systems (ITS) have been a major focus in the transportation industry. Engineers, researchers, and policy makers have worked to develop, test, deploy, categorize, and structure countless technologies to improve the safety and efficiency of nearly every aspect of the transportation system.

ITS applications are serving highway, transit, rail, and pedestrian and bicycle systems. Only in the past 5 years, however, have researchers investigated and studied ITS technologies to improve safety and efficiency in school transportation systems on a regional or larger scale.

The number of children making daily school trips by automobile poses problems. Health advocates argue that more children should use pedestrian or cycling modes for school trips. School districting policies, however, preclude many children from nonmotorized modes because home-to-school distances are too long.

From a traffic engineering perspective, if students who live too far away to walk or bike would travel by school bus, the automobile demands on the street networks adjacent to schools would decrease. School-related automobile traffic causes queueing on nearby streets and increases commuter delays. Injury and fatality statistics show that large numbers of school trips by automobile also contribute to safety problems.

Collecting Data

To determine if the benefits of implementing AVL on school buses could prompt a significant shift from travel by private automobile, data were collected from survey questionnaires completed by parents of children in kindergarten through eighth grade in the public school system of Wake County, North Carolina (*3*). The demographics suggest that this area is a representative suburban community of the southeastern United States.

High school students were not included in the data collection because driving has social implications for that age group in suburban environments. The influences on a high school student's decision to drive—or to ride with a driving friend or relative—to and from school were not easy to express quantitatively for statistical evaluation. Moreover, a preliminary assessment determined that the reasons for driving were not likely to be influenced by benefits from the addition of AVL technology to school buses.

Right: Palm Beach School District in Florida is the largest school district to use global positioning systems (GPS) to track its fleet of school buses.

PHOTO: GEOSPATIAL TECHNOLOGIES, INC.

Below: School district dispatchers use real-time vehicle information and locations to track and reroute vehicles as needed.

The school district buses are mounted with a unit (*left*, GST Tracker from GeoSpatial Technologies) that combines geographic information system, GPS, wireless communications, and Internet map servers.

Data on approximately 250 students in kindergarten through eighth grade were analyzed to assess the impacts of AVL on the choice of mode for school trips. Although information was received for more than 700 students, only 255 met the criteria for inclusion in the assessment. Three classes of students were excluded from the analyses:

1. Students who lived within walking distance of the school,
2. Students who lived beyond the base attendance area for the school, and
3. Students already riding the school bus both in the morning and in the afternoon.

In addition to obtaining information about student, household, and school trip characteristics, the survey included two questions to assess the potential for changes in response to AVL technologies:

- *If your child does not ride the school bus, would you allow him/her to ride if for a charge of $5-$10 per month you would be provided with a pager that would sound in your home a few minutes before the bus actually arrived (shortening the time that you and/or your child must wait at the bus stop)?*
- *If your child does not ride the school bus, would you allow him/her to ride if the school bus positions were monitored regularly at the school transportation office (increasing student safety and improving the on-time arrival of buses)?*

AVL Functions

These questions were based on specific AVL systems available for school buses. The systems use Global Positioning System (GPS) and two-way radio or cellular communications for vehicle tracking, providing periodic real-time vehicle position updates to a central computer. The software displays the bus locations and other information, such as speed, on area maps that can zoom to the street level.

Another function is to provide traveler information. GPS transmitters on board school buses receive positional coordinates, which are relayed to receivers in homes and schools. Pager-like devices that contain the receiver notify the households about the arrival of the bus (*4*).

Some units dynamically display a countdown of the distance from the bus to the assigned bus stop. Other units transmit an audible sequence of beeps about five minutes before bus arrival, alerting students to be at the bus stop.

The notifications provide the rider with safety benefits and increase the operating efficiency of the school bus system. Bus annunciation systems work well in areas where "school children and their parents…walk long distances to their bus stop and then wait with great uncertainty for their school bus to arrive. The waiting exposes children to all kinds of inclement

weather conditions, roadside safety hazards, and other personal safety and security threats" (5).

The AVL analysis focused on the potential for a modal shift in school trips after the implementation of vehicle tracking and traveler information on school buses.

Modal Shift Potential

To determine quantitatively how likely a student would be to change from the automobile to the school bus after the application of one or both of the AVL functions, parents' answers to the two specific questions were assigned numerical probabilities:

- A "yes" to either question was assigned a probability of 1.0, meaning that the child would definitely shift modes under the given circumstances.
- If the parent answered "maybe," a probability of 0.5 was assigned, to represent a 50-50 likelihood of switching from the private automobile to the school bus.
- If the answer was "no," a probability of 0.0 was assigned, to indicate that the student was not at all likely to shift modes.

Assigning numerical probabilities was necessary for a quantitative analysis of the survey results. The numeric values may be imprecise but are not arbitrary, because they reflect as closely as possible a student's likelihood to shift modes based on the parental response to the survey.

The computed probabilities of modal shifts cannot be definite, because personal opinions change. If the same respondents were to participate in the survey a second time, changes in the answers to the AVL assessment questions would be likely.

For each of the 255 students, a mode shift probability was computed for the two AVL functions—vehicle tracking and traveler information. The overall probability of a mode shift by an individual student was calculated by adding two quantities: one-half of the probability of shifting to the school bus if bus tracking technologies were installed, plus one-half of the probability of shifting to the school bus if traveler information technologies were installed.

For example, a parent who answered "no" to the question about traveler information and household notification and "yes" to the question about vehicle tracking would register an overall mode shift probability of 0.5, according to the following computation:

$$\frac{1}{2}(0.0) + \frac{1}{2}(1.0) = 0.5$$

The average probability of a mode shift for the entire data set was calculated to be 0.40, indicating that 40 percent of all students using the automobile for at least their morning school trip may shift to the school bus for at least one trip if vehicle tracking and traveler information technologies were deployed on the school buses. Specifically, 50 percent of the students who came to school by automobile in the morning and returned by school bus in the afternoon may shift to the school bus with the addition of vehicle tracking and traveler information technologies.

Of the students riding in an automobile for morning and afternoon school trips, 30 percent indicated a possibility of shifting to the school bus. The difference between the 50 percent and 30 percent is intuitively reasonable, because students already using the school bus service for one trip would be more likely to shift modes and use the school bus for both trips than students who do not use the school bus service at all.

If 40 percent of all students using the automobile for the morning trip or for both school trips shifted to the school bus for the morning school trip, the overall modal shift would be 16 percent. A 16 percent shift from the automobile to the school bus in a school district the size of Wake County, with a student population of approximately 104,000, would increase school bus ridership by more than 16,500 trips. The size of this shift could decrease traffic congestion around the school and could increase student safety, with so many students transferring to the statistically safer school bus mode.

Parental Preferences

The separate consideration of the effects of the notification and the tracking technologies may be useful for school districts that cannot afford a complete AVL system.

Some traveler information and household notification systems, for example, operate independently of AVL. These systems transmit a signal from a unit on board a school bus to the in-home pagers associated with the route. When the bus comes within 1 mile of a pager programmed with the corresponding code, the pager sounds, notifying the household that the children should begin moving to the bus stop.

Would notification alone prompt a large enough shift to justify the necessary expenditures? According to the survey results, more parents indicate a willingness to shift modes in response to the benefits of the bus tracking function than in response to the benefits of household notification.

The average likelihood of a shift in modes in response to the availability of traveler information is 28 percent, and the average likelihood of a shift in modes in response to the availability of vehicle tracking technologies is 51 percent. The results suggest that parents would assign more value to school transportation staff's knowing the location of the buses than to advance notification of the arrival time of the school bus.

TABLE 1 Average Probability of Shifting from Personal Automobile to School Bus for at Least One Morning or Afternoon School Trip

AM Mode, PM Mode *	Overall Modal Shift Probability	Traveler Information Probability	Vehicle Tracking Probability
AU, SB	0.50	0.40	0.60
AU, AU	0.30	0.20	0.40
SB, AU	0.50	0.20	0.80
Total	0.40	0.28	0.51

** AU = personal automobile, SB = school bus*

The parental preference for bus tracking technologies may be explained by other results of the survey, which show an on-time school bus arrival rating of 70 percent. Parents likely assigned less value to notification because the buses arrived at the regularly scheduled times. A summary of the modal shift probabilities is presented in Table 1.

AVL and Mode Choice

A second component of the school transportation research project was to determine the factors that influence the choice between school bus and personal automobile for students in kindergarten through eighth grade. Statistical analyses of the individual, household, and trip characteristics of these students, living beyond a walkable distance, found that six independent variables were statistically significant predictors of mode choice (*3*):

- The total number of children in kindergarten through eighth grade in the household;
- The student's grade level;
- The average median household income for the zip code boundary in which the student lives;
- The school transportation mode that the parent perceives to be most safe;
- The convenience of the automobile for school trips in an individual household in relation to student schedules, automobile ownership, and ability to chain trips and to carpool; and
- Parent work schedules, safety concerns, and other problems and technologies that promote or constrain school bus use.

Some of these variables are subjective and disallow widespread use of the model without intensive data collection. The variables were included in the analysis, however, to account for each factor that might have significant influence on mode choice for school trips.

The AVL improvements to the school bus, for example, could be incorporated into the school bus convenience factor to reflect the additional convenience of AVL tracking or notification technologies for individuals and households. The research results suggest that increases in the school bus level of service through AVL should be included in the modeling for school trip mode choice.

The school bus and automobile convenience terms also could be redefined to be less subjective. Automobile convenience could include only household automobile ownership, and school bus convenience could include only the presence or absence of AVL technologies.

Another Study's Findings

A school trip mode choice study conducted by the U.S. Environmental Protection Agency (EPA) also investigated the influences on mode choice for school trips (*6*; see article by Ewing, Forinash, and Schroeer, page 4). The models estimated the shares of four school trip modes—car, bus, bicycle, and walking—to assess the implications of school siting for travel.

The researchers considered a range of independent variables from the categories of trip, traveler, school, and characteristics of the built environment. The variables found to influence school trip mode choice significantly were the following:

- Annual household income;
- The number of vehicles per household member;
- Walk time for the trip, along minimum path distances at the nominal walking speed of 3 miles per hour (mph);
- Bike time for the trip, along minimum path distances at the nominal biking speed of 12 mph;
- The proportion of street miles with sidewalks, averaged for the origin and destination zones; and
- Average accessibility indices for the origin and destination zones, determined by the number of trip attractors in a zone and the travel time between the trip zones.

The results from EPA's school trip mode choice models do not support the significance of AVL tech-

PHOTO: ZETRON

Grand Prairie Independent School District (ISD) near Dallas, Texas, modernized its school bus dispatch by installing radio communication and automatic vehicle location (AVL) systems (Integrator RD from Zetron).

nologies on school buses in influencing choice of mode. None of the independent variables could reflect the effects that adding AVL to school buses would have on mode choice.

The EPA models are multinomial logit models—each study unit had a choice among four modal alternatives. The models for the Wake County study, however, are binomial, estimating the modal share between the motorized options of school bus and personal automobile.

Another difference in the studies is the grade level of the students—the EPA study included all grade levels, kindergarten through 12th grade. The differences in the studies' findings suggest that AVL technology improvements to school bus level of service decrease in influence on mode choice as the modal options expand and as the grade level of the students increases.

Adverse Impacts

Increasing school bus ridership by a considerable amount, such as 16 percent, may not produce entirely positive effects. School transportation staff who deal with fleet logistics would have to estimate the additional number of buses and drivers needed to accommodate the increase and put these into operation quickly to maintain the level of service.

In North Carolina, the state government uses an efficiency rating to allocate funds for school transportation, calculated primarily from a ratio of the number of students transported and the number of buses used. A source for the initial funding of the additional buses and bus driver salaries would have to be identified, until the district could prove the need for the increase with the change in ridership counts. The school district must be prepared to handle the increase in ridership if the addition of technology is to be effective.

School bus–related crashes also may increase as the number of students using the school bus service increases. According to NHTSA, a school bus–related crash is any injury or fatality that occurs in the vicinity of a school bus, even if the school bus was not directly involved. An increase in school bus–related crashes may not be notable and may be offset by other factors, yet school transportation staff should note that an increase may occur.

Quality and Efficiency

The research indicates the potential for a significant modal shift from the personal automobile to the school bus after the deployment of AVL tracking technologies. Traveler information technologies, which notify households about a school bus arrival, were not as important to parents as vehicle tracking. This is likely because 70 percent of school buses arrive on time in the county, according to the survey results.

PHOTO: ZETRON

Antennas mounted on top of ISD school buses function as part of radio communication and AVL.

Nonetheless, with both the tracking and notification functions implemented, a modal shift as large as 16 percent could result.

Potential applications of this school transportation research are many. School districts can focus resources on solutions to school transportation problems that have a proven impact on mode choice. Manufacturers can generate more effective AVL products with the greatest potential for increasing school bus ridership.

Overall, quality and efficiency of travel could increase in communities throughout the country as the results of this research are applied. Fewer personal automobiles on school campuses can be expected to decrease crashes between vehicles, pedestrians, and buses, increasing the safety of students, school staff, and commuters.

Acknowledgments

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How Risky Is the Commute to School?

Deaths and Injuries by Transportation Mode

ANN M. DELLINGER AND LAURIE BECK

The authors are with the National Center for Injury Prevention and Control, Centers for Disease Control and Prevention, Atlanta, Georgia. Dellinger was a member of the National Research Council–appointed Committee on School Transportation Safety, which produced TRB Special Report 269, The Relative Risks of School Travel: A National Perspective and Guidance for Local Community Risk Assessment.

In the United States, motor vehicle crashes are the leading cause of death among children (*1*). Although the laws mandating school attendance vary from state to state, all children must attend school until they are at least 16 years old. Because almost all children and youth 5 to 18 years old are enrolled in school, the school commute becomes an important source of exposure to the traffic environment.

In previous generations, many children walked or rode bicycles to school. In the early 1970s, for example, an estimated 66 percent of children walked to school. Since then, increased reliance on motor vehicles for transportation, changes in the commuting distance between housing and schools, and changes in zoning and building regulations have had an impact on the way children get to school.

The risk of injury or death during the school commute varies by mode of transportation. The Transportation Research Board's Special Report 269, *The Relative Risks of School Travel: A National Perspective and Guidance for Local Community Risk Assessment*,[1] documented findings that only 2 percent of student deaths were related to school buses and that a disproportionate share of passenger vehicle-related student deaths occurred when a teenager was driving (*2*).

Because the environment of school travel is

[1] www.TRB.org/publications/sr/sr269.pdf. To order, www.TRB.org/bookstore/.

PHOTO: DAN BURDEN, WALKABLE COMMUNITIES, INC.

changing, a periodic assessment of the risks to children and youth during school commutes is important. Following is an examination of changes in injury risk over time by transportation mode.

Obtaining and Defining the Data

The data were obtained from three sources:

- The Fatality Analysis Reporting System (FARS), an annual census of all fatal crashes on public roadways in the United States—to identify the number of deaths (*3*);
- The National Automotive Sampling System's General Estimates System (GES), a nationally representative sample of all police-reported crashes—to estimate the number of nonfatal injuries (*4*); and
- The U.S. Census Bureau's population estimates—to calculate rates by dividing the number of deaths in a period by the number of children and youth in the period, multiplied by 100,000 (*5*).

The FARS and GES records do not specify the purposes of the trips. Therefore a weekday morning time period was defined during which travel by school-age children and youths was likely to be to school. Afternoon trips from school could be to home or to a variety of other locations—such as work or sports—and therefore were not addressed in the study.

All motor vehicle–related deaths and injuries involving school-age children and youth between September 1 and May 31—approximating the typical 9-month school year—and from Monday to Friday between 6:00 a.m. and 8:59 a.m. were assumed to have occurred on a trip to school. Data were reported for two 3-year periods:

- Period 1: September 1, 1993, to May 31, 1996; and
- Period 2: September 1, 1999, to May 31, 2002.

The 3-year periods increased the sample sizes for deaths and injuries by transportation mode. The larger samples were necessary for modes that have few deaths per year, such as buses.

Deaths and injuries were classified by mode of transportation. Children and youths could be injured as vehicle occupants or as pedestrians or bicyclists.

Motor vehicles were grouped as passenger vehicles—including cars, light trucks, and sport utility vehicles; school buses; other buses, such as transit; or all other vehicles—for example, motorcycles or recreational vehicles. Passenger vehicles were further classified as having young drivers under 21 years old or adult drivers 21 or more years old. Rates per 100,000 population were then compared across the 3-year periods.

PHOTO: DAN BURDEN, WALKABLE COMMUNITIES, INC.

Determining Rates

More than 300 children and youths 5 to 18 years old were killed each year in motor vehicle crashes during the approximated trip to school. An estimated 40,000 to 50,000 were injured as vehicle occupants, pedestrians, or bicyclists. The rates of deaths and injuries varied by mode of transportation.

The highest death rate during the two 3-year periods was for occupants of vehicles driven by persons under 21 years old (0.36 per 100,000). The number of deaths in vehicles with drivers under 21 years old during the two periods was comparable, although the rates decreased slightly, from 0.36 in 1993–1996 to 0.33 in 1999–2002.

The death rates involving school buses, other buses, and other or unknown vehicles were based on small numbers and should be considered unstable. For example, school buses were involved in 12 deaths during Period 1 and in 7 deaths during Period 2; the rate for the 7 deaths in Period 2 was 0.004—a very small number that is lost when reporting to only two decimal places. Consequently, calculating a difference for school buses between Period 1 and 2 was not possible. The number of deaths decreased from 946 in Period 1 to 922 in Period 2 when data for all transportation modes were combined (see Table 1).

The rates for nonfatal injuries, like the rates for deaths, were highest for passenger vehicles driven by young drivers. The categories of other buses and other or unknown vehicles had the lowest injury rates. Between Periods 1 and 2, injury rates decreased for all transportation modes except other buses, for which

TABLE 1 Deaths and Injuries to Children 5 to 18 Years of Age from Motor Vehicle Crashes During Morning Hours,[a] Monday Through Friday, September Through May,[b] by Mode of Transportation, 1993–1996 and 1999–2002

	Deaths			Injuries[c]		
	Period 1 Number (3-year Rate)[d]	Period 2 Number (3-year Rate)[d]	Rate Change	Period 1 Number (3-year Rate)[d]	Period 2 Number (3-year Rate)[d]	Rate Change
School Bus	12 (0.01)	7 (0.00)	Unable to calculate	9,576 (6.08)	5,085 (2.96)	Decrease
Other Bus	0 ( )	0 ( )	No deaths	1,101 (0.70)	2,094 (1.22)	Increase
Pedestrian	165 (0.11)	136 (0.08)	Decrease	9,628 (6.11)	8,698 (5.06)	Decrease
Bicyclist	22 (0.01)	11 (0.01)	No change	5,064 (3.21)	2,920 (1.70)	Decrease
Passenger Vehicle Driver Age ≤ 20	565 (0.36)	566 (0.33)	Decrease	76,868 (48.79)	62,944 (36.63)	Decrease
Passenger Vehicle Driver Age ≥ 21	168 (0.11)	189 (0.11)	No change	48,990 (31.10)	41,228 (23.99)	Decrease
Other/Unknown	14 (0.01)	13 (0.01)	No change	1,027 (0.65)	577 (0.34)	Decrease
Total	946 (0.63)	922 (0.54)	Overall decrease	152,253 (96.6)	123,546 (71.9)	Overall decrease

[a] *6:00 a.m.–8:59 a.m.*

[b] *Period 1 includes the 9-month approximated school years from September 1, 1993, through May 31, 1996. Period 2 includes the 9-month approximated school years from September 1, 1999, through May 31, 2002.*

[c] *Numbers and rates of injuries are based on estimates from a nationally representative sample of crashes.*

[d] *Rates per 100,000 population.*

the injury rate increased. The school bus and bicyclist categories had the largest decreases. Taking all modes together, total injuries decreased from 152,253 in Period 1 to 123,546 in Period 2 (see Table 1).

Managing the Risks

The risk of death or injury on the trip to school varied by mode of transportation—with the highest death and injury rates for children in passenger vehicles. These data also indicated some decrease in risk between 1993 and 2002.

Assessing the practical change in rates, however, is difficult with the small sample sizes. For example, the injury rate for pedestrians changed from 6.11 in Period 1 to 5.06 in Period 2—a 17 percent decrease. Yet when projected to the nation as a whole, this change represented only one fewer injury per 100,000 students.

Recently, in an effort to curb obesity in children, the public health community has encouraged walking and bicycling to school. These modes of transportation have obvious physical health benefits, but safety concerns also must be acknowledged and addressed.

The solution may be as simple as having adults walk children to school or ensuring that bicyclists wear helmets. Similarly, on every trip, those who travel in passenger vehicles should encourage all occupants to use proper restraints—such as safety belts, child safety seats, or booster seats.

Since the 1993–1996 school years, few meaningful changes have emerged in the rates of deaths and injuries related to school travel. Those charged with protecting the safety of schoolchildren can apply the recommendations in TRB Special Report 269 to select safe modes of transportation and to manage the risks for each mode under a variety of strategies. Evaluating and identifying interventions that are effective and that can be replicated widely can help achieve the complementary goal of safe school transportation.

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Child Passenger Safety Restraints in School Buses

Update on Regulations and Training

SUSAN KIRINICH

Recent changes in recommendations and regulations have affected the use of child restraint systems (CRS) in school buses. A major challenge is training parents, bus drivers, and assistants to install the systems correctly. Making a CRS compatible with the school bus seat may require special solutions, such as changing the webbing length of the school bus seat belt so that the buckle does not interfere with the CRS installation.

To help school transportation providers and educators deal with these problems, the National Highway Traffic Safety Administration (NHTSA) has developed an 8-hour workshop, Child Passenger Safety Training for School Bus, based on the Standardized Child Passenger Safety Training program. A certified child passenger safety instructor or technician must teach the course, which is offered in partnership with the National Association of State Directors of Pupil Transportation Services. NHTSA's website soon will post a list of state contacts.[1]

PHOTO: SAFEGUARD BUS SEATS

Heritage Christian School in Indianapolis, Indiana, installed lap shoulder belts in its fleet of 11 school buses.

NHTSA has issued several regulations and recommendations that affect the use of CRSs on school buses. For example, the Lower Anchors and Tethers for Children (LATCH) system, which connects a car seat to anchors mounted in the vehicle, has been required in two seating positions on all school buses of 10,000 pounds or less (gross vehicle weight rating) since September 2002; the tether connection, however, is not required. The system is optional on larger school buses.

In 2004, NHTSA issued a final rule that allowed safety vests to be attached directly to school bus seat backs. Safety vests use a strap that wraps around the back of the seat, for attaching to the harness system. The new rule warns that the seat immediately behind should be vacant or the occupant restrained by a safety belt or other CRS.

NHTSA also has updated a recommendation on the reuse of CRSs after a vehicle crash. The update, however, does not address school buses directly, and NHTSA is reviewing the recommendation to provide more specific guidance. The revised guideline is scheduled for release this summer.

[1] www.nhtsa.dot.gov

PHOTO: SAFEGUARD BUS SEATS

Sled test of "seat within a seat" design (SafeGuard's SmartFrame) gauges effectiveness of lap-shoulder restraint for buckled students, as well as extent of maintaining protection for unbuckled students.

The author is Program Manager, School Transportation and Pedestrian Safety, National Highway Traffic Safety Administration, Washington, D.C.

Addressing Security Risks in School Transportation

PETE BAXTER, CHARLES GAUTHIER, AND JOHN GREEN

Baxter is with the Division of School Traffic Safety and Emergency Planning, Indiana Department of Education, Indianapolis. Gauthier is Executive Director, National Association of State Directors of Pupil Transportation Services, The Plains, Virginia. Green is Supervisor, Office of School Transportation, California Department of Education, Sacramento.

NOTE: *Point of View presents opinions of contributing authors on transportation issues. The views expressed are not necessarily those of TRB or* TR News. *Readers are encouraged to comment in a letter to the editor on the issues and opinions presented.*

School bus transportation comprises a significant portion of highway travel—more than 4 billion vehicle-miles per year—and the vehicles carry large numbers of children every school day. Many security professionals have recognized that school buses are a "soft target"—that is, easy to attack. Terrorist acts aimed at children have occurred in other parts of the world and have included attacks on school buses.

In the United States, communities must take action to ensure the highest levels of security for school bus transportation. Like so many other aspects of life after the attacks of September 11, 2001, school bus transportation poses new challenges to maintaining security.

The realities of the security risks and threats in school bus transportation therefore must be examined, along with information about the various approaches that school bus transportation professionals can take to identify and minimize risks and threats. A key step in this process would be to study school bus structural features that may affect the response of law enforcement officers to a potential terrorist situation. A forum also should be established for extended discussion on the importance of ensuring the security of children on school buses and for the sharing of best-practice approaches.

Security Warnings

School buses constitute the largest highway public transportation system in the United States, providing 10 billion passenger trips per year. Each school day, approximately 500,000 school buses transport 25 million students to and from school and carry millions more to athletic events, extracurricular activities, and field trips.

Terrorist activities in other parts of the world have not spared schoolchildren. In Beslan, Russia, more than 150 children were among the 331 people killed after a two-day hostage situation in a school. Are schoolchildren in the United States at risk?

In July 2004, the media reported that the U.S. military in Iraq had found terrorist hideouts that contained information about several U.S. schools. In September 2004, the Federal Bureau of Investigation notified school districts in six states that unidentified individuals had obtained photographs and diagrams of local school buildings, as well as copies of emergency preparedness plans. In an October 2004 letter, the U.S. Department of Education alerted school districts across the nation about possible terrorist targeting of school facilities, including school buses.

During the past year, thefts of school bus equipment and vandalism of school buses have increased in the United States. Hundreds of thefts of two-way radios from school buses in two states have led to a major law enforcement investigation. The concern is that unauthorized individuals may be able to monitor communications between dispatchers and school buses or may be able to provide school bus drivers with false information or directions. The stolen radios also could be used for communication among criminals or terrorists.

Large-scale vandalism of safety features on school buses, such as brakes and tires, also has increased in

frequency in the past year. These may not be terrorist activities but demonstrate the vulnerability of school buses—for example, to the planting of explosive devices.

To call attention to this vulnerability, a school bus driver in one state filed several false bomb threats against buses. Although the driver was arrested and convicted of a misdemeanor, the point was made about the lack of school bus security measures.

Initiating Responses

We must recognize and accept the need for new awareness in response to the terrorist activities and threats of the past few years. We also need a thorough understanding of the potential impact of terrorism and other acts of violence that may target pupil transportation. Finally, we must develop programs and plans to avoid or minimize the effects of possible acts of terrorism.

The protection of our children starts with ensuring that the most routine tasks and functions are safe and secure. We must educate and train students, parents, teachers, administrators, and especially drivers in the techniques and methods of preparedness.

Determining an appropriate level of action, however, is difficult. Overreaction may elicit undue fears from the public about riding school buses. The credibility of the pupil transportation industry with our partners in prevention—such as local law enforcement and emergency responders—requires investment in knowledge, training, and professionalism.

How do we become more aware and prepared? We should establish our security initiatives on the fundamentals of personal safety:

- **Vigilance.** Denying the likelihood of terrorist acts and citing the lack of precedents can make our industry an easy prey. A false sense of security, as well as apathy and ignorance, are allies of those who perpetrate violence and harm.
- **Audits.** Assess the level of security. Most school transportation operations have safety committees—security should be added to their activities.
- **Education.** Learn the threats to the operation and be proactive in prevention. Take training classes, attend lectures, and read published material from experts on security, such as the Transportation Security Administration.
- **Policies and procedures.** Develop policies and procedures for drivers, dispatchers, mechanics, first-line supervisors, and administrators for the management of security incidents. The administration, school board, or board of directors should review, endorse, and adopt these policies and procedures officially. The policies should be published, so that all parties are aware of them and have access to them.
- **Training.** All personnel should receive training in the adopted policies and procedures and should know their specific roles and responsibilities. Written policies and procedures will not succeed unless personnel are trained to use them. Practice sessions should be scheduled to determine if the training has been successful and to identify any shortcomings.
- **Supervision.** Supervisors must set the example for compliance with the policies and procedures and must make sure that employees follow suit. Supervisors must foster an environment that promotes awareness, preparedness, and due diligence by adhering to security policies and procedures daily.

Other Preparations

The structural characteristics of school buses should be an early topic of study. Local law enforcement personnel, terrorist response task forces, emergency rescue teams, and related groups must be knowledgeable about how school buses are built—the construction and materials differ from those of transit buses and motorcoaches.

All of the appropriate organizations ideally should have an opportunity to practice a security scenario involving a school bus. Another essential step would be to create a digital photo library for each type and manufacture of school bus, to provide a variety of information, such as engine location and type; fuel type, fuel tank location, and capacity; battery location; and entrance door and emergency exit locations—including the operation of each feature.

Forum for Discussion

An old saying states that smart people learn from their own mistakes, but wise people learn from the mistakes of others. In the past century, the school bus transportation industry was both smart and wise in terms of safety, not only responding to mistakes, but also cooperating and complying with every regulatory action at the federal and state levels. The results are noteworthy and admirable—school buses are the safest type of motor vehicle on the nation's highways.

Society and the school bus transportation industry now must take whatever actions are necessary to ensure that the safest form of highway travel also becomes the most secure. The statistical likelihood of being involved in a terrorist attack may be miniscule—nevertheless, taking actions for prevention is prudent and necessary.

By identifying the terrorist threat at its extreme and taking reasonable and appropriate actions, we may decrease the risk of a terrorist act, as well as the likelihood of less serious but more common acts of crime directed at school transportation. It is the least we can do for our passengers!

Reducing the Illegal Passing of School Buses

Video Footage Assists in Documentation, Training, and Raising Public Awareness

JEFFREY C. TSAI AND DEREK GRAHAM

Tsai is Program Director, Pupil Transportation Group, Institute for Transportation Research and Education, North Carolina State University, Raleigh. Graham is Section Chief, Transportation Services, North Carolina Department of Public Instruction, Raleigh.

According to TRB Special Report 269, *The Relative Risks of School Travel: A National Perspective and Guidance for Local Community Risk Assessment,*[1] the school bus is the safest mode of school transportation in the United States. Nonetheless, the nation experiences an average of 20 school bus–related fatalities per year. One-third of these fatalities occur when motorists illegally pass a stopped school bus, ignoring the flashing red warning lights and the deployed stop-sign arm.

Problem

North Carolina school districts operate more than 13,000 school buses daily, and illegal passing of school buses takes place an average of 1,900 times each day. In North Carolina, the stop arm violation—passing a stopped school bus while the side-mounted stop sign is deployed—is the only type of traffic violation for which law enforcement relies on citizen reports. The violation also carries the second highest penalty for a moving violation, next to the penalty for driving while intoxicated.

Law enforcement officers, however, have questioned the validity of some violation reports. Occasional stepped-up enforcement efforts often produce few or no observed violations.

The North Carolina Department of Public Instruction and the Institute for Transportation Research and Education at North Carolina State University set out to find ways to reduce the illegal passing of stopped school buses. The study focused on three coastal school districts: Onslow, Pender, and New Hanover counties. In Onslow County, a high level of collaboration among agencies—plus the use of external, bus-mounted video cameras—led to notable success.

[1] www.TRB.org/publications/sr/sr269.pdf

Solution

Gathering Stakeholders

At the initial project meeting with stakeholders, law enforcement officers were skeptical about the magnitude of the problem and about the validity of the reported violations. Officers also expressed concerns about the deployment procedures for stop arms, particularly the way that some drivers sometimes activate the stop arm before coming to a stop, in an attempt to control traffic. Because of this, some violation reports filed by bus drivers had been dismissed and were not pursued through the judicial system.

The first step of the project, therefore, was to conduct a question-and-answer session for all stakeholders. The goal was to ensure that the law enforcement officers who issue the citations, the district attorneys who seek the convictions, the bus drivers who file the violation reports, and the bus driver trainers all agree on what constitutes illegal passing of stopped school buses.

Video Cameras

To address questions about the school bus stop arm deployment procedures, the project team conducted a study using video cameras. The Onslow County project team mounted weatherproof video cameras outside the bus near the stop arm of selected school buses operated by drivers who had reported frequent illegal passing. The video cameras recorded the date, the time, the speed of the bus, the activation of the amber warning lights, and the deployment of the stop arm.

The initial use of the video cameras was to perform a time and motion study of how bus drivers were operating the traffic control devices—the amber warning lights, the red warning lights, and the stop arm. The videos showed that bus drivers sometimes failed to come to a complete stop before activating the red warning lights and stop arm.

The daily recordings for each bus also captured at

Video footage snapshot documents a passing violation while the school bus was stopped (vehicle speed is 0) and the stop arm was deployed (red warning lights were activated).

least one or two vehicles illegally passing while the stopped bus was loading and unloading school children. Because the footage documented that the school bus was stopped and that the stop arm was deployed, the violations were easily verified.

The transportation director for Onslow County Schools shared the findings from the daily footage with local highway troopers. The footage convinced the law enforcement officers of the magnitude of a problem observed only rarely by patrols.

Training Drivers

The focus on stop arm violations and the implementation of the video technology brought the school system transportation staff and law enforcement agencies together to work toward a common goal. The time and motion study revealed that drivers may not have followed consistently the procedures for making passenger stops.

In North Carolina, school bus drivers are trained to activate the vehicle's amber warning lights 300 feet before the stop, stop the bus 15 feet short of the closest waiting passenger, come to a complete stop, check the traffic, and then open the door. Opening the door activates the red warning lights and the stop arm. The time and motion study revealed that drivers did not keep to the 300-foot warning stage and sometimes deployed the stop arm before the bus came to a complete stop.

The video footage pointed out the need for continued education of school bus drivers. A brochure and 6-minute video, "Your School Bus Passenger Stop: Consistency Makes the Difference," were developed and distributed throughout the state.

The training videotape emphasizes that the school bus drivers' only ways to communicate with motorists are through the vehicle's amber warning lights and red flashing lights. The bus driver must use these warning devices consistently, so that motorists can anticipate when and where the bus will make a stop.

After the reinforcement training in Onslow County, the average daily number of reported violations of the no-passing law filed by the 203 bus drivers dropped. The one-week tally declined from 22.6 to 15 violations per day.

Raising Awareness

Onslow County added more video cameras to the fleet. Working with the district attorney's office, law enforcement agencies issued citations to owners of the vehicles involved in the recorded violations. The locations of the violations also were mapped on a geographic information system, along with the times of the violations, allowing officers to identify high-incident locations for increased enforcement.

Motorists who realize the dangers inherent in the violation will be less likely to pass the stop arm. A key goal of the project, therefore, was to heighten public awareness. Radio advertising, television advertising, press conferences, and educational materials spread the message, along with promotions during School Bus Safety Week and at the North Carolina State Fair.

Television stations in Onslow County incorporated the video footage from the school buses into evening news reports. The result was a further decrease in stop violations.

Frame from school bus driver reinforcement training videotape, produced by the North Carolina Department of Public Instruction and the Institute for Transportation Research and Education, North Carolina State University, with funding from the National Highway Traffic Safety Administration.

Application

The success of Onslow County Schools' experience with video cameras recording school bus stop arm violations spurred great interest from other school districts. Manufacturers of cameras for the school bus industry competed to create more sophisticated units for videotaping inside and outside of school buses.

Laws governing the use of video footage for prosecution may vary from state to state. At the least, however, videos can supply critical evidence to law enforcement agencies that the illegal passing of school buses is a problem.

Benefits

During the 18-month project—which combined cooperation from law enforcement agencies, the reinforced training of school bus drivers, and a public awareness campaign—stop arm violations in Onslow County declined from 22.6 to 7.6 per day, a 67 percent reduction. Other school districts have had similar success using video cameras to document school bus stop arm violations.

Media coverage continues to bring the issue to public attention. The video footage also highlighted the need for continued training of school bus drivers on the proper procedures for making passenger stops.

Since 1997, the North Carolina Department of Public Instruction has maintained a statewide survey of school stop arm violations of all 13,000-plus school buses on a single day—usually a Wednesday—in March. The statewide record indicates that 1,500 to 2,000 times a day a motorist illegally passes a stopped school bus, endangering the lives of students. The data also show that 3 to 4 percent of the violations occur on the right side of the bus, where students are boarding or off-loading.

School bus drivers, school district transportation staff, law enforcement officers, and motorists have key roles in preventing this risky act. Technology can be a valuable tool, but compliance requires hard work and determination. Onslow County's concerted efforts demonstrate that it is possible to reduce the number of violations and to improve the protection of schoolchildren.

For further information contact Jeffrey Tsai, Institute for Transportation Research and Education, North Carolina State University, Campus Box 8601, Raleigh, NC 27695-8601, phone 919-515-7931, fax 919-515-7924, e-mail jeff_tsai@ncsu.edu; or Derek Graham, North Carolina Department of Public Instruction, 6319 Mail Service Center, Raleigh, NC 27699-6319, phone 919-807-3571, fax 919-807-3578, e-mail dgraham@dpi.state.nc.us.

EDITOR'S NOTE: Appreciation is expressed to Peter Shaw, Transportation Research Board, for his efforts in developing this article.

Suggestions for "Research Pays Off" topics are welcome. Contact G. P. Jayaprakash, Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001 (telephone 202-334-2952, e-mail gjayaprakash@nas.edu).

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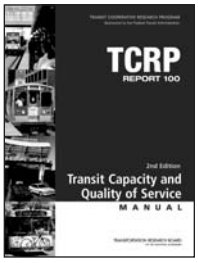
For more than 50 years, transportation analysts worldwide have turned to TRB's Highway Capacity Manual (HCM) for tools to improve the safety, security, and reliability of surface transportation networks. The HCM presents state-of-the-art techniques for estimating the capacity and determining the level of service for transportation facilities, including intersections and roadways, as well as facilities for transit, bicycles, and pedestrians. HCM 2000, in either U.S. customary or metric units, is available in print and CD-ROM. In addition to the full text of both versions of the book, the CD-ROM includes tutorials, narrated example problems, explanatory videos, navigation tools, hyperlinks between sections, and easy access to application software that can be purchased separately from vendors.

- U.S. customary print version (HCM2KE), 1,134 pages, binder, 2000, ISBN 0-309-06746-4, $100.00
- U.S. customary print version with CD-ROM (HCM2EC), ISBN 0-309-06746-4, 1,134 pages, binder, 2000, $145.00
- Metric print version (HCM2KM), 1,134 pages, binder, 2000, ISBN 0-309-06681-6, $100.00
- Metric print version with CD-ROM (HCM2MC), 1,134 pages, binder, 2000, ISBN 0-309-06681-6, $145.00
- Set of two CD-ROMs: U.S. customary and metric versions (HCM2KC), 2001, $90.00

Transit Capacity and Quality of Service Manual, 2nd Edition



The Transit Cooperative Research Program (TCRP) has revised and expanded the fundamental reference document for public transit practitioners and policy makers. The volume contains background, statistics, and graphics on the various types of public transportation and provides a framework for measuring transit availability and quality of service from the passenger's point of view. Presented are quantitative techniques for calculating the capacity of bus, rail, and ferry transit services, and of transit stops, stations, and terminals.

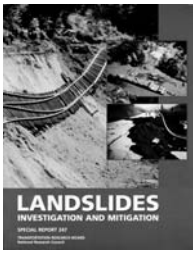
- TCRP Report 100 (TC100), 572 pages, 8.5 × 11 paperback, 2003, ISBN 0-309-08776-7, $45.00

Access Management Manual

This comprehensive textbook details access management techniques, along with information on how to develop and administer effective access management programs. The approach integrates planning and engineering practices with the transportation and land use decisions that contribute to access outcomes. Topics addressed include principles, effects, and techniques of access management; government roles; location and design procedures for access features; and policy, regulatory, and legislative considerations.

- Print version (AMM03), 388 pages, 8.5 × 11 paperback, 2003, ISBN 0-309-07747-8, $80.00
- CD-ROM (AMM03C), 2003, $60.00
- Print version and CD-ROM set (AMM03S), $100.00

Landslides: Investigation and Mitigation



International in scope, this volume assembles comprehensive, practical discussions of field investigations, laboratory testing, and stability analysis procedures and technologies; comprehensive references to the literature; and discussions of case studies, state-of-the-art techniques, and research directions. The report comprises five sections: (1) Principles, Definitions, and Assessment; (2) Investigation; (3) Strength and Stability Analysis; (4) Mitigation; and (5) Special Cases and Materials.

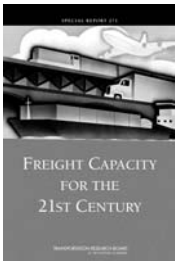
- Special Report 247 (SR247S), 673 pages, 8.5 × 11 paperback, 1996, ISBN 0-309-06208-X, $56.00

The Workforce Challenge: Recruiting, Training, and Retaining Qualified Workers for Transportation and Transit Agencies

This policy study addresses ways in which the transportation community can adjust to workforce challenges and to labor market realities through human resource activities. In recruiting, training, and retaining employees within the transportation industry, success depends on identifying strategic needs and applying a mix of measures to meet the needs. The report recommends establishment of a coalition to expand federal and academic resources, create an institutional focus, and establish human resources management as a strategic function within transportation organizations.

- Special Report 275 (SR275), 186 pages, 6 × 9 paperback, 2003, ISBN 0-309-08563-2, $23.00

Freight Capacity for the 21st Century



Projections of freight demand over the next two to three decades are reviewed and compared with estimates of available infrastructure capacity. The report identifies possible shortfalls in capacity for efficient freight movement, assesses potential policy responses, and presents research needs. Changes are recommended in government transportation programs to improve the provision of capacity by promoting more efficient management of facilities, better investment decisions, and more effective institutional responses to changing needs.

- Special Report 271 (SR271), 155 pages, 6 × 9 paperback, 2003, ISBN 0-309-07746-X, $23.00

TRANSPORTATION RESEARCH BOARD
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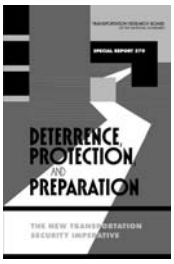
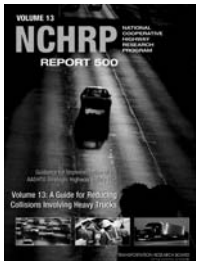
Deterrence, Protection, and Preparation: The New Transportation Security Imperative



The role of science and technology in countering terrorism is examined, and advice is presented for a strategic approach to transportation security that recognizes the need to move people and goods efficiently and the need to improve security against terrorism. The report emphasizes a systematic approach to security, building security into operations, and layering security measures to deter—and to protect against—terrorist attacks.

- Special Report 270 (SR270), 84 pages, 6 × 9 paperback, 2002, ISBN 0-309-07710-9, $20.00

Guidance for Implementation of the AASHTO Strategic Highway Safety Plan



This series of guides from the National Cooperative Highway Research Program (NCHRP) can assist state and local agencies implementing measures to reduce injuries and fatalities in targeted areas. The guides correspond to the areas of emphasis outlined in the American Association of State Highway and Transportation Officials' (AASHTO) Strategic Highway Safety Plan. Each guide includes a brief introduction, a general description of the problem, strategies and countermeasures to address the problem, and a model implementation process. The latest volumes in the series are

- Volume 7: A Guide for Reducing Collisions on Horizontal Curves, NCHRP Report 500 (NR500G), 84 pages, 8.5 × 11 paperback, 2004, $22.00
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- Volume 9: A Guide for Reducing Collisions Involving Older Drivers, NCHRP Report 500 (NR500J), 98 pages, 8.5 × 11 paperback, 2004, $22.00
- Volume 10: A Guide for Reducing Collisions Involving Pedestrians, NCHRP Report 500 (NR500K), 133 pages, 8.5 × 11 paperback, 2004, $24.00
- Volume 11: A Guide for Increasing Seatbelt Use, NCHRP Report 500 (NR500L), 60 pages, 8.5 × 11 paperback, 2004, $20.00
- Volume 12: A Guide for Reducing Collisions at Signalized Intersections, NCHRP Report 500 (NR500M), 123 pages, 8.5 × 11 paperback, 2004, $24.00
- Volume 13: A Guide for Reducing Collisions Involving Heavy Trucks, NCHRP Report 500 (NR500N), 111 pages, 8.5 × 11 paperback, 2004, $22.00

(Volumes 7–13: ISBN 0-309-08760-0.)

Public Transportation Board Effectiveness: A Self-Assessment Handbook

Any assessment of the effectiveness of a board of directors in handling the policy making and oversight of a nonprofit public enterprise—such as a transit system—is defined by the scope of the evaluation, the persons who perform the evaluation, and the social, economic, and political environment. This report provides a self-assessment process to measure public transportation board effectiveness, along with tips on how to change board characteristics to improve effectiveness. The handbook identifies the board characteristics that influence transit system performance.

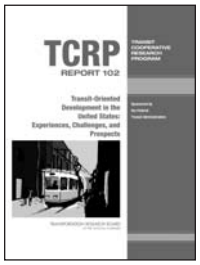
- TCRP Report 104 (TC104), 37 pages, 8.5 × 11 paperback, ISBN 0-309-08802-X, 2004, $19.00

From Handshake to Compact: Guidance to Foster Collaborative, Multimodal Decision Making

Improving management of the transportation system involves maximizing opportunities and resources with creative ways of sharing ideas, information, funding, facilities, and staff through partnerships and agency realignments to deliver a service or function. This NCHRP-TCRP report provides examples of collaboration in multimodal decision making. The report offers practical advice on identifying, implementing, and sustaining collaborative activities.

- NCHRP Report 536/TCRP Report 106 (NR536 or TC106), 67 pages, 8.5 × 11 paperback, ISBN 0-309-08818-6, 2005, $20.00

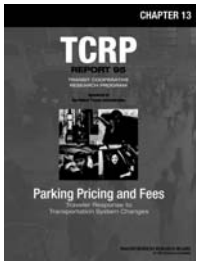
Transit-Oriented Development in the United States: Experiences, Challenges, and Prospects



Focusing development around transit facilities increases accessibility, supports community and regional goals of improving quality of life, and enhances the financial success of transit investments. This TCRP report examines the state of the practice and the benefits of transit-oriented development and joint development throughout the United States.

- TCRP Report 102 (TC102), 524 pages, 8.5 × 11 paperback, ISBN 0-309-08795-3, 2004, $45.00

Traveler Response to Transportation System Changes Handbook



This series of TCRP reports constitutes a comprehensive, readily accessible, interpretive documentation of results and experience in the United States and elsewhere from (*a*) a variety of transportation system changes and policy actions and (*b*) alternative land use and site development approaches. Each chapter of the handbook is published as a stand-alone report, with self-contained references and sources. Ten of the 19 chapters are available; the most recent are

- Chapter 3: Park-and-Ride/Pool: Traveler Response to Transportation System Changes, TCRP Report 95 (TC095C), 92 pages, 8.5 × 11 paperback, $20.00
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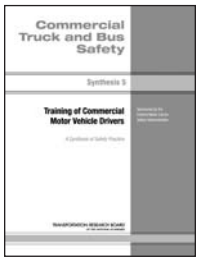
(Chapters 3, 10, 12, and 13: ISBN 0-309-08763-5.)

Training of Commercial Motor Vehicle Drivers



According to the Federal Highway Administration, large trucks accounted for 4% of the nation's registered vehicles, 7% of traffic volume, and 13% of all fatal crashes in 2000. This CTBSSP synthesis reviews training strategies and curricula from commercial driver training programs, identifying training tools and techniques that hold the greatest potential for improving commercial motor vehicle safety.

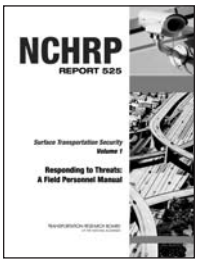
- CTBSSP Synthesis 5 (CTBS05), 36 pages, 8.5 × 11 paperback, ISBN 0-309-08816-X, 2004, $19.00

Predicting Air Quality Effects of Traffic-Flow Improvements: Final Report and User's Guide

The impacts of traffic-flow improvements on household trip making, destination choice, time-of-day choice, mode choice, and route choice are incorporated into this comprehensive methodology for predicting air quality effects. The report evaluates methods for estimating the impacts of traffic-flow improvement projects on mobile-source emissions, reviews the advanced methodologies of leading metropolitan planning agencies, and offers suggestions to improve conventional travel models.

- NCHRP Report 535 (NR535), 227 pages, 8.5 × 11 paperback, ISBN 0-309-08819-4, 2005, $28.00

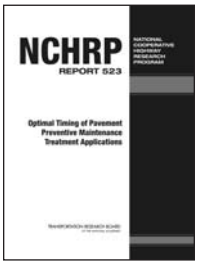
Surface Transportation Security



This new series assembles concise volumes on specific security problems and related issues. The volumes focus on concerns that transportation agencies must address when developing programs in response to the terrorist attacks of September 11, 2001, and the anthrax attacks that followed. Additional volumes are in progress.

- Volume 1: Responding to Threats: A Field Personnel Manual, NCHRP Report 525 (NR525A), 17 pages, 8.5 × 11 paperback, ISBN 0-309-08803-8, 2004, $18.00
- Volume 2: Information Sharing and Analysis Centers: Overview and Supporting Software Features, NCHRP Report 525 (NR525A), 228 pages, 8.5 × 11 paperback, ISBN 0-309-08803-8, 2004, $28.00

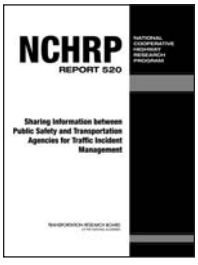
Optimal Timing of Pavement Preventive Maintenance Treatment Applications



As highway budgets shrink, agencies are moving toward preventive maintenance of pavements and away from worst-first programming. This report presents a methodology for determining the optimal timing for preventive maintenance treatments of flexible and rigid pavements.

- NCHRP Report 523 (NR523), 76 pages, 8.5 × 11 paperback, ISBN 0-309-08811-9, 2004, $21.00

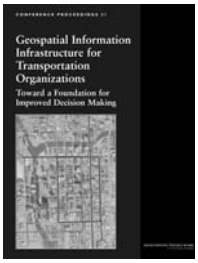
Sharing Information Between Public Safety and Transportation Agencies for Traffic Incident Management



Efficient response to roadway incidents is a public safety and mobility issue—longer response and clearance times mean less effective critical care, more traffic congestion, and reduced mobility. Interagency exchange of information promotes rapid, efficient, and appropriate responses from all agencies. This report presents lessons from around the country on how public safety and transportation agencies share information for managing traffic incidents.

- NCHRP Report 520 (NR520), 86 pages, 8.5 × 11 paperback, ISBN 0-309-08792-9, 2004, $22.00

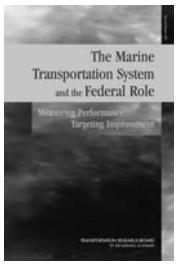
Geospatial Information Infrastructure for Transportation Organizations: Toward a Foundation for Improved Decision Making



The importance of geospatial information in decision making by transportation organizations is the theme of this Conference Proceedings, which includes the authoring committee's recommendations, derived from three workshops held in 2002. Also presented are a selection of current practices, trends in decision-making tools, and a detailed discussion of the committee's findings on geospatial information infrastructure.

- TRB Conference Proceedings 31 (CP031), 70 pages, 8.5 × 11 paperback, ISBN 0-309-09468-2, 2004, $32.00

The Marine Transportation System and the Federal Role: Measuring Performance, Targeting Improvement



The U.S. Department of Transportation (DOT) should take the lead in assessing the performance of the nation's marine transportation system and in making necessary improvements, according to this policy study. The study committee also recommends that U.S. DOT should develop a report on the condition, performance, and use of the marine transportation system and should seek a mandate from Congress to produce the report regularly.

- Special Report 279 (SR279), 180 pages, 6 × 9 paperback, ISBN 0-309-04952-6, 2004, $24.00

Transportation Research Record: Journal of the Transportation Research Board

Transportation Research Records, approximately 40 volumes published throughout the year, collect technical papers on specific transportation modes and subject areas. The series primarily comprises a selection of papers prepared for presentation at TRB Annual Meetings; occasionally papers from other TRB conferences or workshops are included. All papers in TRB's journal series are peer reviewed.

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TRB SPECIAL REPORT

Does the Built Environment Influence Physical Activity?

Examining the Evidence

NANCY P. HUMPHREY

The author, Senior Program Officer, TRB Division of Policy Studies and Information Services, served as manager for this project with Carrie I. Szlyk, Program Officer, Institute of Medicine.

Physical inactivity is a major, largely preventable threat to health. The scientific evidence is compelling that regular physical activity—even at moderate levels, such as walking briskly for 30 minutes on 5 or more days per week—reduces the risk of premature mortality and of developing various chronic diseases; improves psychological well-being; and helps prevent weight gain and obesity by keeping caloric intake in balance with energy expenditure.

Despite the scientific evidence, 55 percent of the U.S. adult population fall short of the recommended guidelines, and approximately 25 percent report being completely inactive when not at work. Nearly one-third of high school–age teenagers report not meeting recommended levels of physical activity, and 10 percent classify themselves as inactive.

Study Charge

Concerned about the adverse health effects of physical inactivity, The Robert Wood Johnson Foundation and the Centers for Disease Control and Prevention requested a study to examine how the built environment potentially contributes to reduced levels of physical activity in the United States. The built environment is broadly defined to include land use patterns, the transportation system, and design features that together generate needs and provide opportunities for travel and physical activity.

In response to this request, the National Research Council of the National Academies, under the auspices of the Transportation Research Board and the Institute of Medicine, formed a committee of 14 experts from the transportation and public health communities (see box, page 32). The expertise of the panel members covers such diverse fields as transportation demand and travel behavior, land use planning and regulation, public health, physical activity and education, economics and public policy, safety, and social and behavioral science research and methods.

The study charge was to review the general trends affecting the relationships among physical activity, health, transportation, and land use; to summarize what is known about these relationships, including the strength and magnitude of any causal connections; to draw implications for policy; and to recommend priorities for research.

PHOTO: DAN BURDEN, WALKABLE COMMUNITIES, INC.

Aerial view of suburban development.

Gathering Information

The committee commissioned several papers to explore various aspects of the relationships among land use, transportation, and physical activity.[1] The papers examined long-term trends in land use patterns, travel behavior, employment, and time use related to physical activity levels; critically reviewed the literature on these relationships; and elaborated on the methodological and data challenges.

Other papers addressed the role of social marketing in shaping individual preferences and behavior; the importance of safety and security; institutional

[1] The papers are available online at www.TRB.org/downloads/sr282papers/sr282paperstoc.pdf.

TRB Special Report 282, Does the Built Environment Influence Physical Activity? *Examining the Evidence*, is available from the TRB online bookstore, www.TRB.org/bookstore; to view the book online, go to www.TRB.org/publications/sr/sr282.pdf.

and regulatory forces that affect what is built and where; and educational programs that link public health and urban planning. The committee also drew from a paper on the role of segregation and poverty in limiting choices for physical activity among disadvantaged populations.

In addition, the committee arranged for briefings and held a workshop to involve a broader range of experts from academia, consulting firms, professional associations, advocacy groups, state and federal agencies, congressional staff, and the press.

Role of the Built Environment

In the past half-century or more, technological innovations have reduced the physical requirements of daily life substantially. Automation has led to the decline of physically active occupations; other trends include the introduction of labor-saving devices in the home and the dominance of the automobile for personal travel.

In addition, the steady decentralization of metropolitan-area population and employment to low-density, widely dispersed suburban locations has increased the travel distances to many destinations, such as schools, shopping places, and transit stops. This has made the private vehicle the most practical means of transport. Lifestyle and cultural changes, such as increases in television watching and other sedentary activities, also have played a role in reducing physical activity.

In contrast to the well-documented causal connection between physical activity and health, the role and importance of the built environment in physical activity levels is a relatively new area of inquiry. The literature on the topic is at an early stage of development but is growing rapidly.

Photo: Dan Burden, Walkable Communities, Inc.

Pennsylvania Avenue serves as major thoroughfare for vehicle traffic and pedestrians in Washington, D.C.

Complex Relationshsips

Shaped by the long-standing policies and the practices of elected officials, policy makers, planners, developers, traffic engineers, and other decision makers, the built environment can facilitate or constrain physical activity. The relationship between the built environment and physical activity, however, is complex and operates through many mediating factors, such as sociodemographic characteristics, personal and cultural variables, safety and security, and time allocation.

Empirical evidence links the built environment and physical activity, but few studies capable of demonstrating a causal relationship have been conducted, and evidence supporting a causal relationship is sparse. Weaknesses in the literature include lack of a sound theoretical framework, inadequate research designs, and incomplete data.

Longitudinal study designs are needed to investigate causal relationships between the built environment and physical activity, as well as studies that carefully distinguish between such determinants of physical activity as personal attitudes, residential location preferences, and characteristics of the built environment. Appropriate measures of the built environment are still in development, and efforts to link the measures to travel and health databases are at an early stage.

Committee on Physical Activity, Health, Transportation, and Land Use

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Facilitating Activity

Built environments that facilitate more active lifestyles and reduce barriers to physical activity are desirable because of the positive relationship between physical activity and health. Achieving this goal is a challenge for a highly technological society with an extensive built environment that is often expensive to change.

Nevertheless, the built environment is being renovated and rebuilt constantly, and new developments are being constructed. Renovation and construction offer opportunities to institute policies and practices that produce activity-conducive environments.

Many settings offer opportunities to increase physical activity levels—at home, at work, at school, in travel, and in leisure. The built environment can influence physical activity in each of these settings.

The available evidence, however, is not sufficient to identify the changes that would have the most impact on physical activity levels and health outcomes. Research has not yet identified causal relationships that would have enabled the committee to provide guidance about cost-beneficial investments or to state unequivocally that such changes to the built environment would lead to more physical activity or would be the most efficient ways of increasing such activity.

Recommendations

The committee's recommendations are presented in detail in the published report. Given the current state of knowledge and the importance of physical activity for health, the committee urges a continuing and well-supported research effort.

Priorities for research include interdisciplinary approaches and international collaboration; more complete conceptual models; better research designs; and more detailed examination and matching of specific characteristics of the built environment with different types of physical activity. All types of physical activity should be included, to allow substitutions among different types. From a public health perspective, the goal is to increase total physical activity levels.

Other recommendations call for expanding national public health and travel surveys to provide more detailed information about the location of physical activity and travel; evaluating changes to the built environment as natural experiments to be studied for their impacts on physical activity; and emphasizing interdisciplinary education programs at universities to train professionals for research and to prepare practitioners at the intersection of physical activity, public health, transportation, and urban planning.

Federal funding is needed to support high-payoff, but difficult to finance, multiyear longitudinal studies; to establish a rapid response capability to evaluate natural experiments as they arise; and to make recommended additions to national databases if research into important causal connections is to be undertaken. To meet these targeted needs, the committee recommends that the leadership of the U.S. Department of Health and Human Services and the U.S. Department of Transportation work collaboratively to shape an appropriate research agenda and to recommend to Congress a program of research with a defined mission and a proposed budget.

PHOTO: DAN BURDEN, WALKABLE COMMUNITIES, INC.

Marked crosswalks across multilane intersection.

PHOTO: DAN BURDEN, WALKABLE COMMUNITIES, INC.

Roundabout and vegetation median calm traffic in Boca Raton, Florida.

CALENDAR

TRB Meetings
2005

May

8–11 International Workshop on Life-Cycle Cost Analysis and Design of Civil Infrastructure Systems*
Cocoa Beach, Florida

11–13 Census Data for Transportation Planning: Preparing for the Future
Irvine, California

22–25 National Roundabout Conference
Vail, Colorado

June

6–9 Southwest Community Impact Assessment Workshop*
Scottsdale, Arizona

20–24 7th International Symposium on Utilization of High Strength–High Performance Concrete*
Washington, D.C.

27–30 3rd International Driving Symposium on Human Factors in Driver Assessment, Training, and Vehicle Design*
Rockport, Maine

27–July 2 3rd International Symposium on Highway Geometric Design
Chicago, Illinois

July

8–9 Commodity Flow Survey Conference
Boston, Massachusetts

10–12 TRB 2005 Summer Conference
Boston, Massachusetts

10–12 30th Annual Summer Ports, Waterways, Freight, and International Trade Conference
Boston, Massachusetts

11–13 Symposium on Stormwater Management for Highways
Sanibel Island, Florida

17–19 Environmental Stewardship in Transportation Through Waste Management, Materials Reuse, and EMS
Charlotte, North Carolina

17–20 6th International Bridge Engineering Conference
Boston, Massachusetts

17–20 44th Annual Workshop on Transportation Law
Portland, Oregon

August

13–18 8th International Conference on Concrete Pavements*
Colorado Springs, Colorado

September

11–14 Northeast Community Impact Assessment Workshop*
Trenton, New Jersey
Martine Micozzi

22–24 International SIIV Congress on People, Land, Environment, and Transport Infrastructures*
Bari, Italy

October

2–5 SmartRiver21: International Symposium on Global Commerce and Strategies for Inland Navigation and Economic Development*
Pittsburgh, Pennsylvania
Joedy Cambridge

5–7 Road Safety on Four Continents*
Warsaw, Poland

31–Nov. 1 1st National Workshop on Roadway Pavement Preservation for Surfaced and Unsurfaced Roads
Kansas City, Missouri
Frederick Hejl

November

1–3 6th National Conference on Transportation Asset Management—Making Asset Management Work in Your Organization*
Kansas City, Missouri

14–16 2005 International Truck and Bus Safety and Security Symposium*
Alexandria, VA
Richard Pain

2006

January

22–26 TRB 85th Annual Meeting
Washington, D.C.
Linda Karson

Additional information on TRB conferences and workshops, including calls for abstracts, registration and hotel information, lists of cosponsors, and links to conference websites, is available online (www.TRB.org/trb/calendar). Registration and hotel information usually is available 2 to 3 months in advance. For information, contact the individual listed at 202-334-2934, fax 202-334-2003, or e-mail lkarson@nas.edu/. Meeting listings without TRB staff contacts have direct links from the TRB calendar web page.

*TRB is cosponsor of the meeting.

TRB 2005 ANNUAL MEETING HIGHLIGHTS

PROVIDING A SAFE, SECURE, AND INTEGRATED SYSTEM

84th Annual Meeting Spotlights Transportation from the Customer's Perspective

More than 9,500 transportation researchers, practitioners, and administrators representing government, industry, and academia from the United States and abroad gathered in Washington, D.C., January 9–13, 2005, to participate in the 84th Annual Meeting of the Transportation Research Board. The 5-day program offered attendees a variety of opportunities for information sharing and interaction with more than 2,600 presentations in nearly 470 sessions; 67 specialty workshops; 350 meetings of committees, subcommittees, and task forces; 66 meet-the-author poster sessions; and many additional events. The spotlight theme of the meeting—Transportation from the Customer's Perspective: Providing a Safe, Secure, and Integrated System—tied many of the diverse program sessions together. Details and highlights appear on the following pages.

Annual Meeting photography by Cable Risdon Photography

SESSIONS & WORKSHOPS

The Annual Meeting sessions were developed by the approximately 200 standing committees in the 11 groups of TRB's Technical Activities Division. Members of the incoming Technical Activities Council, who chair the 11 groups, met midday Sunday (*left to right:*) Operations and Maintenance: Leland Smithson, Iowa Department of Transportation (DOT); Marine: Larry Daggett, Waterway Simulation Technology, Inc.; Design and Construction: David Suits, New York State DOT; System Users: Barry Sweedler, Safety & Policy Analysis International; Legal Resources: Brelend Gowan, California DOT; Rail: Christopher Barkan, University of Illinois–Urbana Champaign; Freight Systems: Christina Casgar, U.S. DOT; TRB Technical Activities Director Mark Norman; Council Chair Neil Pedersen, Maryland State Highway Administration; Policy and Organization: Robert Johns, Center for Transportation Studies; and Public Transportation: Patricia McLaughlin, Moore Iacofano Golstman, Inc. (Not pictured are Planning and Environment: Marcy Schwartz, CH2M Hill; and Aviation: Agam Sinha, MITRE Corporation.)

Spotlighting the Customer's Perspective

More than 40 sessions focused on the spotlight theme, "Transportation from the Customer's Perspective: Providing a Safe, Secure, and Integrated System." Sessions outlined what customers need and want from transportation organizations and systems. Leading transportation providers explained what transportation organizations are doing and can be doing to meet customer expectations. *Left,* Thomas Donohue, U.S. Chamber of Commerce, provides the business and carriers' perspective during a session on mega-trends in delivering goods.
Below (left to right): 2004 Executive Committee Chair Michael Townes, Hampton Roads Transit; presiding officer Anne Canby, Surface Transportation Policy Project; and William Wilkinson, National Center for Bicycling & Walking, participate in a panel discussion on what travelers need and want from transportation organizations and systems.

The Federal Transit Administration (FTA) has relied on measures of ridership, accessibility, safety, and infrastructure condition to justify continued investment in the federal transit program. Session presenters critiqued these measures and examined alternatives for proving the program's value. (*Left to right:*) Christopher Boylan, Metropolitan Transportation Authority; Brigid Hynes-Cherin, FTA; Mortimer Downey, PB Consult, Inc.; David Lewis, HLB Decision Economics, Inc.; and Thomas Deen, retired TRB Executive Director.

Tony Dalrymple, Johns Hopkins University, presents satellite images of coastal damage sustained after the tsunamis of December 2004, during a special session on the transportation and logistical challenges facing southeast Asia. Presenters discussed airlift and sealift of aid and relief supplies; rebuilding infrastructure in developing countries; impacts of the disaster on commercial shipping and global supply chains, public health, and environment; and U.S. military involvement.

In 2004, Congress passed legislation to dismantle the Research and Special Programs Administration (RSPA) and to establish the Research and Innovative Technology Administration (RITA) in the U.S. DOT. During a well-attended session, members of the transportation community were invited to share their thoughts on setting strategic directions for transportation research. *Above left,* TRB Executive Director Robert Skinner, Jr., opened the panel discussion by suggesting seven criteria for judging the new agency's success or failure: stakeholder involvement, balance between long- and short-term research, internal coordination and leadership, coordination with stakeholders and other agencies, research and development (R&D) quality, scale of R&D efforts, and private-sector participation. *Above right,* Edward Fluhr, Travel Industry Association of America, joins other attendees in questioning panelists.

(*Left to right:*) Allan Rutter, North Texas Tollway Authority; D. J. Gribbin, Federal Highway Administration (FHWA); Robert Prieto, Fluor Corporation; Geoffrey Yarema, Nossaman Guthner Knox Elliott, LLP; James Taylor, Bear Stearns; and FHWA Administrator Mary Peters hold an open forum discussion on private-sector involvement in project financing and delivery of state highway projects. The session addressed strategies for encouraging public–private partnerships.

(*Left to right:*) Kenneth Stackpoole, Embry-Riddle Aeronautical University; Bob Pearce, Joint Planning and Development Office (JPDO); Nancy LoBue, Federal Aviation Administration (FAA); and Jaiwon Shin, NASA, examine the policy and practical issues related to the Integrated National Plan for the Next Generation Air Transportation System. The multiagency JPDO will present Congress with the plan to meet FAA's safety, security, mobility, efficiency, and capacity needs for 2025 and beyond.

Cathal "Irish" Flynn, retired Rear Admiral, U.S. Navy, and former Associate Administrator for Civil Aviation Security, FAA, discusses airport security during a half-day workshop that identified threats to the processing of passengers, baggage, and cargo; evaluated strategies for countering threats; and examined responsibilities for developing new approaches and technologies.

(*Left to right:*) Susan Ferguson, Insurance Institute for Highway Safety; Sandra Rosenbloom, University of Arizona; and presiding officer Gloria Jeff, Michigan DOT, summarize studies presented at the November 2004 Research on Women's Issues in Transportation Conference. Research examined crash safety for pregnant women; the relationship between community design and women's personal safety; and the reasons why women travel more often, link more trips together, and use toll roads more than their male counterparts.

Susan Hanson, Clark University, summarizes findings in the newly released TRB Special Report 282, *Does the Built Environment Influence Physical Activity?* The report examines general trends affecting the relationships among physical activity, health, transportation, and land use.

David Shinar, Ben Gurion University of the Negev, Israel, presents research on safe headways between automobiles, in the keynote speech at the Human Factors Workshop Luncheon.

Kay Fitzpatrick, Texas Transportation Institute, presides at a Human Factors Workshop on approaches to reducing speeds on U.S. highways and residential streets. Speakers addressed speed advisory signs, rumble strips, and locations at which speed management treatments are or are not effective.

(*Left to right:*) Presiding officer Robert Tuccillo, FTA; Shelley Poticha, Center for Transit-Oriented Development; and Gerald Arrington, PB PlaceMaking, discuss the national trends in transit networks of light rail lines, subways, commuter rail, and bus rapid transit. The session examined how to improve the implementation of transit-oriented development in conjunction with new and existing fixed guideway systems.

Pierce Homer (*left*), Virginia DOT, and Marsha Kaiser, Maryland DOT, discuss concepts for managing freeway congestion through variably priced high-occupancy and general-purpose lanes. Both states are considering proposals to create express toll lanes that could provide the option of congestion-free travel in the national capital region.

Trefor Williams (*left*), Rutgers University, and Douglass Couto, Michigan Department of Information Technology, preside at a half-day workshop on using information technology to improve management of construction projects.

The TRB Design and Construction Group held an inaugural forum to honor two experts who have made significant contributions to transportation research. Honoree Michael Katona, Washington State University, discussed soil–structure interaction, and honoree Don Ivey, Texas A&M University System, spoke about highway safety. (*Left to right:*) Design and Construction Group Chair Gale Page; Structures Section Chair Mary Lou Ralls; Katona; Ivey; Design Section Chair Barbara Petrarca; and Paul Scott, TBE Group, Inc.

SESSIONS & WORKSHOPS

(*Left to right:*) E. G. Edmonson, Journal of Commerce Group; Michael Howard, J. B. Hunt Transport Services, Inc.; Paul Nowicki, Burlington Northern and Santa Fe Railway Company; and Basil Maher, Maher Terminals, Inc., participate in a four-part mega session on the global supply chain. The session explored the effect that changing trade patterns have on ports of entry; the roles that gateways play in expediting the distribution of freight between modes; changing facility and site requirements; and the role of federal, state, and local policy in infrastructure planning and funding.

A four-part mega session covered the topic of cargo tracking for supply chain integration. Patricia Hu, Oak Ridge National Laboratory, presided at the second session, which addressed outlooks in cargo tracking by the Department of Defense, the Federal Motor Carrier Safety Administration, the Department of Homeland Security, and the U.S. Postal Service.

(*Left to right:*) Lee Husting and Ted Hitchcox, National Institute for Occupational Safety and Health; Ann Williamson, University of New South Wales; Michael Conyngham, International Brotherhood of Teamsters; Kiu Sik Bae, Korea Labor Institute; and Michael Belzer, Wayne State University, participate in a session that examined the health and safety of transportation workers. Presenters discussed drug use, long working hours, and the effects of economic competition.

Mark Lepofsky, Battelle Memorial Institute, discusses the findings of a U.S. DOT–sponsored field test involving technologies to improve the safety and security of hazardous materials transportation.

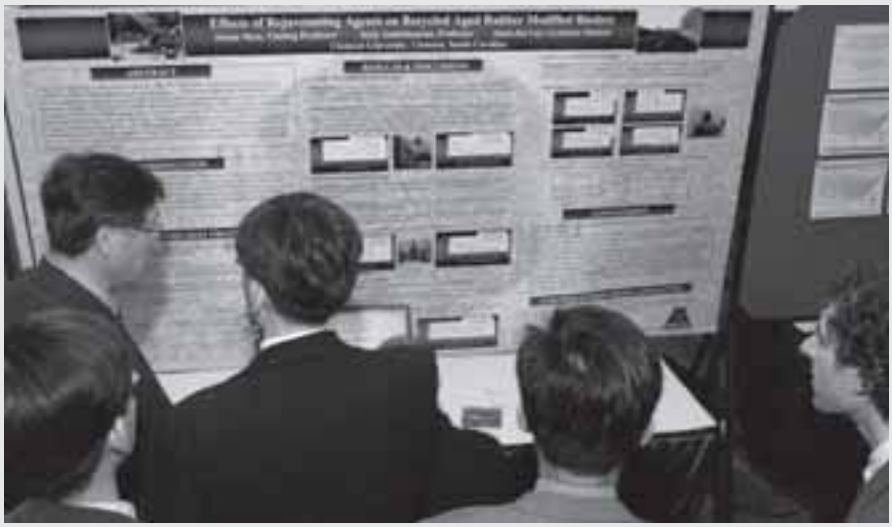
(*Left to right:*) Eberhard Jäensch, DB–Netz AG; Francisco Javier Calvo, University of Granada; presiding officer Daniel Roth, Booz Allen Hamilton; and Nicola Shaw, United Kingdom Strategic Rail Authority, give presentations on Western Europe's use of open or shared access to rail networks. The session examined the success of pricing and management mechanisms and the complications created by the diversity of mechanisms.

Presiding officer Matthew McDole (*left*), E-470 Public Highway Authority, and Timothy Brown, Parsons Transportation Group, participate in a session that examined how to meet quality objectives through design–build, from the perspectives of contractors, engineering consultants, inspection and testing consultants, and owners.

Karen Borlaug Phillips, Canadian National Railway Company, provides a rail perspective on future negotiations about the North American Free Trade Agreement.

Poster Sessions

Meet-the-Author Poster Sessions provided participants with an opportunity to interact with authors in a more personal setting than the conventional lecture. *Right,* Xiao Kuan Yang, Beijing University of Technology, discusses research on preventing fatal crashes on the BaDaLing Freeway in China, during the poster session on transportation infrastructure, safety, and planning in developing countries. *Below,* The poster describing the effects of rejuvenating agents on recycled aged rubber-modified binders attracted attention at the poster session on general issues in use and characterization of asphalt binders.



Ali Porbaha, California State University, discusses recent U.S. projects that have applied accelerated construction technologies to construct embankments on soft ground in a faster, safer, and more reliable manner than conventional approaches.

Barbara Sisson, FTA, presides over a session on the need for further research on bus rapid transit (BRT) to quantify performance measures, socioeconomic impacts, and the benefits of selective vehicle technologies. The session included a case study of the Bogotá, Colombia, BRT system, which has generated positive financial and operational results.

SESSIONS & WORKSHOPS

William Withuhn, Smithsonian Institution, presides over a workshop examining the impact of transportation on visitor experience in national parks. Participants focused on new research to define the dimensions of visitor experience and how transportation affects those dimensions.

Fred Wagner (*far right*), Beveridge & Diamond, PC, presents slides on automobile collisions with deer, during a session on wildlife management. (*Left to right:*) Mark Cheskey, KCI Technologies, Inc.; Walter Eifert, Roux Associates, Inc.; and Edward Melisky, FAA, also participated in the panel discussion about the sometimes-conflicting mandates of reducing hazards to transportation and protecting the environment.

Jon Bryan Burley, Michigan State University, presents findings from a case study of context-sensitive design education on the Old Mission Peninsula, Michigan. Listening is presiding officer Craig Allan Churchward, HNTB Corporation.

Cynthia Cook, an Arlington, Virginia–based consultant, discusses transportation investment in impoverished rural areas of Thailand, during a session on the impact of road construction on developing Asian and African countries.

John Strahan, attorney consultant in Topeka, Kansas, presides over a panel discussion on Indian laws. Panelists addressed the definition of Indian roads, expanded Indian sovereignty, constitutional protections, control of right of way, and binding contracts with tribes. The Eminent Domain Committee will conduct an expanded session on the subject at the 44th Annual Workshop on Transportation Law, in Portland, Oregon, July 2005.

Kevin Krizek, University of Minnesota, presents research on factors affecting discontinuity of on-street bicycle lanes in urban settings.

Performance Measurement Committee Chair Lance Neumann (*left*) was among the standing committee chairs who discussed technical activities at the All Chairs Meeting. Former Technical Activities Council Chair Kathleen Stein (*right*) acted as discussion facilitator.

Anita Vandervalk, Chair of the Statewide Transportation Data and Information Systems Committee, led a Sunday orientation for new chairs in the policy and multimodal groups.

Philip Demosthenes (*standing*), Parametrix, Inc., and Gene Russell (*right*), Kansas State University, give a presentation about research and implementation of roundabouts in the United States to the members of the Roundabouts Joint Subcommittee. The two men are coordinating the National Roundabout Conference in May in Vail, Colorado.

Roger Olson, Chair of the Pavement Rehabilitation Committee, presides at the committee's well-attended meeting.

EXHIBITS

The Exhibit Hall housed recent research projects and products of TRB sponsors. Several attendees examine the range of products offered by the National Highway Institute.

Transportation and Technology Academy (TransTech) students from Cardozo Senior High School, Washington, D.C., operated their first-ever exhibit at the annual meeting. Outgoing Executive Committee Chair Michael Townes (*center*) visits with TransTech coordinator Shirley McCall (*right*) and student Ebony Cooper (*left*) at the exhibit.

Attendee browses the array of TRB publications for sale in the Exhibit Hall.

FHWA hosted an exhibit to showcase innovations in pavement materials testing.

A demonstration of the mechanistic-empirical pavement design guide, developed under the National Cooperative Highway Research Program (NCHRP) Project 1-37A.

The Annual Meeting provides an opportunity for transportation experts from the United States and around the world to share best practices and research. *Above left,* (*left to right:*) Eugene Calvert, Collier County Transportation Services Division, Florida; Bruce Drewes, University of Idaho; Ken Skorseth, South Dakota State University; and Stephen Ford, Mendocino County Department of Transportation, California, hold an informal discussion on technology transfer.

Above right, Hongyan He Oliver, Stanford University, and Nicole Davis, International Sustainable Systems Research Center, examine computer data on vehicle emission models.

Left (*left to right:*) Kate McMahon, U.K. Department of Transport; Martin Lowson, Advanced Transport Systems, Ltd.; and Tony Bliss, World Bank, attend the International Participants Reception on Monday evening.

New Attendees: Tuning into Networks

Above left, Several hundred newcomers to the Annual Meeting attended a welcome and networking reception on Sunday. After a presentation on TRB activities and how to navigate the annual meeting, attendees mingled with committee chairs.
Above right, Barry Sweedler (*center*), chair of the System Users Group, and TRB Technical Activities Director Mark Norman (*right*) identify committee meetings of interest to first-time attendee Charles Stevens.

EXECUTIVE COMMITTEE

TRB Executive Director Robert Skinner, Jr., updates the TRB Executive Committee on recent activities of TRB and the National Academies, during the TRB Executive Committee winter business meeting.

Incoming and outgoing leadership converse during a break in the meeting. *From left:* 2005 Chair Joseph Boardman, New York State DOT; 2005 Vice Chair Michael Meyer, Georgia Institute of Technology; and 2004 Chair Michael Townes, Hampton Roads Transit.

Richard Schmalz, New York State DOT, discusses the challenges faced in rebuilding the arterial roadway adjacent to the World Trade Center. During his presentation at the winter business meeting, Schmalz highlighted federal, state, local, and private coordination activities; efforts to ensure the protection of the local residential and business community; the establishment of the Lower Manhattan Construction Command Center; and the status of major Lower Manhattan projects.

The TRB Executive Committee held a policy session on international roadway safety initiatives. Panelists discussed innovative measures adopted in their countries to deter speeding and alcohol use and to improve road conditions and vehicle safety. Measures included mandatory seatbelt use, daytime running lights, random breath tests, low blood alcohol concentration limits, alcohol interlocks, cell phone bans, intelligent road markers, variable signage, and speed and red-light cameras. (*Left to right:*) Hans Laurell, Swedish National Road Administration; Kate McMahon, U.K. Department for Transport; Ian Faulks, New South Wales Parliament; and David Anderson, VicRoads, Australia.

Gittens

Garber

Morris

Shellabarger and Johnson

The TRB Executive Committee welcomed new committee members and invited guests during the business meeting, including (*clockwise from above left),* Angela Gittens, consultant; Nicholas Garber, University of Virginia; Michael Morris, North Central Texas Council of Governments; Anne Canby, Surface Transportation Policy Project; and Nan Shellabarger, FAA, and Edward Johnson, NASA.

Canby

2002 Executive Committee Chair Dean Carlson was among the committee members completing terms of service, who were recognized at the business meeting.

Carol Murray, New Hampshire DOT, offers input during the business meeting.

C. Michael Walton, Chair of the Subcommittee for National Research Council (NRC) Oversight, reports on the subcommittees' activities in assisting the TRB Executive Committee with the strategic plan and special projects submitted to the NRC Governing Board for approval.

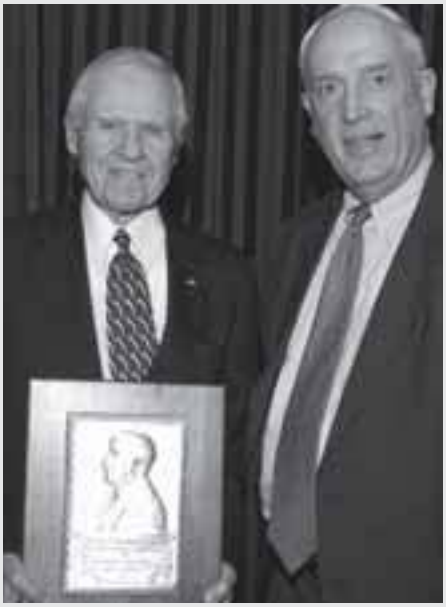
A. Ray Chamberlain, Vice President of Parsons Brinckerhoff and former director of Colorado DOT, received the W. N. Carey, Jr., Distinguished Service Award for his outstanding leadership and service to transportation research and to TRB. Active in TRB for 15 years, he has participated on many committees and panels in several TRB divisions and served as chair of the Executive Committee in 1993. Chamberlain also chaired the National Research Council Committee that produced Special Report 229, *Safety Research for a Changing Highway Environment*. Chamberlain is known for thoughtful, disinterested assessments of complex issues, and for a keen understanding of the real-world context in which transportation decisions are made. 2005 TRB Executive Committee Chair Joseph Boardman (*left*) and 2004 Chair Michael Townes (*right*) presented the award to Chamberlain.

Sandra Rosenbloom, University of Arizona, received the Roy W. Crum Distinguished Service Award for her significant contributions to transportation research. Rosenbloom is internationally recognized for her scholarship on transportation and community development trends—notably suburbanization, aging populations, the increase of mothers in the labor force, and groups with special needs. The author or coauthor of more than 40 peer-reviewed papers, Rosenbloom cowrote the transportation planning chapter of the widely read textbook, *The Practice of Local Government Planning*. Active in TRB for almost 30 years, Rosenbloom chaired the Paratransit Committee for 7 years and currently chairs the committee responsible for the Conference for Research on Women's Issues in Transportation.

Lawrence Dahms, retired Executive Director of the San Francisco Bay Area's Metropolitan Transportation Commission (MTC), was awarded the Frank Turner Medal for Lifetime Achievement in Transportation for his distinguished career in the field, professional prominence, and contributions to transportation management policy. TRB serves as the secretariat for this biennial award, which is sponsored by 16 organizations active in transportation. During Dahms's 23 years at MTC, the metropolitan planning organization (MPO) became a national model. Dahms led efforts to establish two innovative programs that provide incentives for transit-oriented development. A frequent participant in national policy debates, he helped secure the expanded role given to MPOs in the Intermodal Surface Transportation Efficiency Act of 1991. Dahms has served on numerous TRB and NRC committees and panels during his more than 30 years of involvement. He chaired the Technical Activities Council from 1980 to 1982 and the Executive Committee in 1983.

Chairman's Luncheon

The program for the Chairman's Luncheon, hosted by 2004 Executive Committee Chair Michael Townes, included the introduction of new Executive Committee members and officers, an address by featured speaker Brian O'Neill, Insurance Institute for Highway Safety, and presentation of TRB's most prestigious awards.



Richard Stander, Mohican Construction Company, received the George S. Bartlett Award for his outstanding contributions to highway progress. As vice president, president, and then chair of the Mansfield Asphalt Paving Company, Stander built the company into one of Ohio's leading contractors. He partnered with equipment manufacturers to become an early adopter of automatic paver screeds, pneumatic and vibratory rollers, and state-of-the-art asphalt plant production. Stander chaired the American Road and Transportation Builders Association (ARTBA) and was president of the National Asphalt Pavement Association. Active in TRB since the late 1950s, Stander has served on the Flexible Pavement Construction and Rehabilitation Committee for more than 40 years and chaired the Construction Equipment Committee. Peter Ruane (*right*), President and Chief Executive Officer of ARTBA, presented the award given annually by the American Association of State Highway and Transportation Officials, ARTBA, and TRB.

O'Neill Assesses U.S. Highway Safety Record

Brian O'Neill, President of the Insurance Institute for Highway Safety (IIHS) and the Highway Loss Data Institute (HLDI), discussed the progress and failures in improving highway safety in the United States, in the featured speech at the Chairman's Luncheon. In his examination of federal and state safety policies since the 1960s, O'Neill noted the lack of political leadership in making highway safety a high priority.

He contended that more lives could be saved if states reduce speed limits, enact primary safety belt laws, conduct sobriety checkpoints, and utilize speed cameras. O'Neill also noted that well-publicized enforcement of traffic laws is a more effective countermeasure than education programs. In conclusion, he suggested that researchers compare state strategies to see which are most effective in reducing fatalities.

A native of England, O'Neill joined IIHS in 1969 and held numerous high-level positions before becoming president of the organization and the HLDI in 1985. He has conducted research into virtually all aspects of highway loss reduction, including vehicle and highway design, emergency medical care, the effectiveness of traffic laws, and driver behavior. O'Neill is the author of many publications and scientific papers and coauthor of the Injury Fact Book. He has delivered dozens of presentations and has testified before federal and state regulatory agencies, U.S. congressional committees, and state legislatures on issues related to highway safety.

O'Neill served on the National Research Council (NRC) Committee for a Study of Geometric Design Standards for Highway Improvements and the Committee for a Strategic Transportation Research Study: Highway Safety. O'Neill also has been a member of the NRC Committee on Trauma Research and the TRB Steering Committee for the Conference on Highway Safety Research Development and Demonstration.

Brian O'Neill discusses the effectiveness of state policies to curb highway fatalities in his featured speech at the Chairman's Luncheon.

He has served on the editorial advisory boards of Accident Analysis and Prevention and Traffic Safety Evaluation Research Review.

A highway safety expert consulted frequently by print and electronic media reporters, O'Neill appears regularly on NBC Dateline, on other TV news magazine shows, and on network news programs.

Boardman Guides 2005 Executive Committee

Joseph Boardman, Commissioner of New York State DOT, took office as the 2005 chair of the TRB Executive Committee. Active in TRB since 1990, Boardman also will serve as chair of the Executive Committee subcommittees for the National Cooperative Highway Research Program and the Transit Cooperative Research Program (TCRP).

2005 Executive Committee Chair Joseph Boardman (*left*) with predecessor Michael Townes at the Chairman's Luncheon.

At New York State DOT, Boardman served as assistant commissioner for the Office of Public Transportation and first deputy commissioner before he was appointed commissioner in 1997. He also has held several transportation management positions in New York State, including chief operating officer of Progressive Transportation Services in Elmira; commissioner of Public Transportation in Broome County; manager of Rome Transportation and Rome Parking Authority; and general manager of Utica Transit Authority. In 1983, he helped found the New York Public Transit Association, serving as president from 1987 to 1989.

Currently, Boardman is president of the Northeast Association of State Transportation Officials (NASTO) and he serves as chair of the American Association of State Highway and Transportation Officials Standing Committee on Rail Transportation. For TRB, Boardman has served on the Transit Fleet Maintenance Committee, the TCRP Project Panel on Reliability-Based Procedures for Maintenance of Transit Vehicles, the Subcommittee on Planning and Policy Review, and the Subcommittee for National Research Council Oversight.

Boardman received a master of science degree in management science from the State University of New York at Binghamton and a bachelor's degree in agricultural economics from Cornell University.

Succeeding Boardman as vice chair of the TRB Executive Committee for 2005 is Michael Meyer, Professor in the School of Civil and Environmental Engineering at the Georgia Institute of Technology.

Borrone Advocates National Policy to Address Freight Transportation Supply

The 2005 Thomas B. Deen Distinguished Lecture was presented by Lillian Borrone, who retired in 2000 as the assistant executive director of the Port Authority of New York and New Jersey (PANYNJ). In her lecture, "Sparking the Connection: Supplying Freight System Responses to Global Trade Demands," Borrone contended that the United States has not given enough national attention to fostering and improving the transportation assets needed to deliver goods in a global economy.

Borrone: "Our active policies to encourage global trade are out of balance with our passive policies regarding freight transportation supply."

"The growth in trade has been spurred by long-standing national policies advocating open market access," Borrone noted. "We must develop a matching platform to address the quality and efficiency of our transportation connections to the world economy."

To address capacity and quality issues, Borrone recommended the development of a national transportation policy that integrates the modal freight systems and involves environmental, energy, economic development, and security concerns. She outlined the following three-step approach to build infrastructure that meets future needs:

- Develop a policy framework and seek a consensus vision including Congress and the freight stakeholders. This will require strong national freight databases and common analytical tools.
- Identify the resources needed to support a freight policy framework and prepare an action agenda that will match freight demand to freight supply, engage the support team needed to get the job done, and identify the financial resources and applications to support the framework and the people required.
- Set public–private partnership priorities and leverage the best from each. Only through collaboration will the public and private sectors meet the mobility requirements of nationwide and worldwide trade.

Borrone closed her comments by calling on attendees to provide leadership in meeting the challenges of advancing the global freight system.

Borrone is the first woman to receive the lectureship award, which recognizes the career contributions and achievements of an individual in one of the areas covered by the Board's Technical Activities Division. Honorees are invited to present overviews of their technical areas, including the evolution, the present status, and the prospects for the future. TRB will publish Borrone's lecture in the 2005 series of the *Transportation Research Record: Journal of the Transportation Research Board.*

Borrone has held senior positions in the port, aviation, and public transportation sectors. Before being named assistant executive director of PANYNJ, Borrone served for more than 12 years as director of the Port Commerce Department, overseeing the agency's marine terminals, waterfront development, and international relations. Other positions of responsibility that she has held within PANYNJ include director of management and budget, assistant director of aviation, and special assistant to the director of the Terminals Department. Borrone also served in the U.S. DOT as deputy administrator and associate administrator of the Urban Mass Transportation Administration, now the Federal Transit Administration.

In July 2001 Borrone was appointed by President George W. Bush to serve on the U.S. Commission on Ocean Policy. An inaugural member of the Homeland Security Science and Technology Advisory Committee, she currently chairs the board of directors of the Eno Transportation Foundation and is a member of the boards of directors of Blue Cross and Blue Shield of New Jersey and of STV Group, Inc.

In the aftermath of the September 11, 2001, attacks on the World Trade Center, she served as a member of New Jersey Acting Governor Donald DiFrancesco's cabinet as coordinator of the Office of Recovery and Victim Assistance. She was the first woman to chair the TRB Executive Committee, and she has served as chair of the American Association of Port Authorities and president of the Women's Transportation Seminar. Elected to the National Academy of Engineering in 1996, Borrone has received many honors and awards, including TRB's 2001 W. N. Carey, Jr., Distinguished Service Award.

Authors Recognized for Outstanding Research Papers

(*Left to right:*) 2004 Executive Committee Chair Michael Townes, 2004 D. Grant Mickle Award winners Hughes, Richard, Harwood, and Bauer; K. B. Woods Award winners Muench and Mahoney; Charley V. Wootan Award winners Margolis, Zimmerman, and Poister; and outgoing Technical Activities Council Chair Anne Canby.

In conjunction with the Thomas B. Deen Distinguished Lecture, awards were presented to the authors of outstanding papers published in the 2004 series of the *Transportation Research Record: Journal of the Transportation Research Board*.

The K. B. Woods Award for the outstanding paper in the field of design and construction of transportation facilities was presented to Joe Mahoney and Stephen Muench of the University of Washington for their paper, "Computer-Based Multimedia Pavement Training Tool for Self-Directed Learning." Published in Record 1896, the paper presents evidence that the self-directed learning method should be applied in pavement training.

The D. Grant Mickle Award recognizes the outstanding paper in the field of operation, safety, and maintenance of transportation facilities. The 2004 recipients, Karin Bauer, Douglas Harwood, and Karen Richard of Midwest Research Institute; and Warren Hughes, BMI-SG, authored "Safety Effects of Narrow Lanes and Shoulder-Use Lanes to Increase Capacity of Urban Freeways." Published in Record 1897, the paper notes an increase in accident rates after an additional lane was added on urban freeways in California by narrowing lanes or converting shoulders.

The inaugural Charley V. Wootan Award for the outstanding paper in the field of policy and organization was presented to Theodore Poister, Georgia State University, and David Margolis and Douglas Zimmerman, Pennsylvania DOT, for their paper, "Strategic Management at the Pennsylvania Department of Transportation: A Results-Driven Approach." Published in Record 1885, the paper identifies current strengths and opportunities of the strategic management process in Pennsylvania. The award was established in 2004 in memory of the former chair of the TRB Executive Committee and Technical Activities Council.

Mineta Addresses Road Gang

The Road Gang, a 300-member group of regional highway transportation experts, presented major awards and discussed current highway and transportation issues during its Annual Meeting luncheon. *Below,* during his keynote speech at the luncheon, U.S. Secretary of Transportation Norman Mineta commented that the reauthorization of the surface transportation act will be a major priority this year. He said that maintaining the vast infrastructure that connects various transportation modes is the greatest challenge facing the surface transportation network. Furthermore, Mineta warned that the traditional financing mechanisms that built the system are becoming increasingly unsustainable. Mineta praised new federal programs that clear the path for public–private partnerships.

Above, (*left to right:*) 2005 Road Gang President Frank "Rocky" Moretti; Jonathan Gifford, George Mason University; Secretary Mineta; TRB Executive Director Robert Skinner, Jr.; and Technical Activities Director Mark Norman, 2004 President of the Road Gang.

EMERITUS MEMBERSHIP

Standing committees awarded emeritus membership to 40 individuals who provided exemplary leadership and service over a long period. The 2005 group of honorees, recognized at the Annual Meeting, are listed below.

Policy and Organization

Anthony R. Kane
Taxation and Finance

Aad Ruhl
Strategic Management

Kathleen E. Stein
Strategic Management

Ronald W. Tweedie
Statewide Transportation Data and Information Systems

Marcus Ramsay Wigan
Freight Transportation Data

Planning and Environment

Janet Bell
Public Involvement in Transportation

Martin J. Bernard, III
Transportation Energy

William R. Black
Social and Economic Factors of Transportation

Richard S. Marshment
Transportation Planning Applications

Marion R. Poole
Transportation Planning for Small and Medium-Sized Communities

Darwin G. Stuart
Transportation and Land Development

Robert E. Tatman
Waste Management

Montie G. Wade
Transportation Planning Applications; Transportation Planning for Small and Medium-Sized Communities

Design and Construction

Ronald W. Eck
Low-Volume Roads

Asif Faiz
Low-Volume Roads

Stephen W. Forster
Mineral Aggregates

Don Louis Ivey
Utilities

Sanford P. LaHue
Portland Cement Concrete Pavement Construction

Alma P. Moser
Culverts and Hydraulic Structures

Roger E. Smith
Pavement Monitoring, Evaluation, and Data Storage

Shiraz Tayabji
Rigid Pavement Design

Operations and Maintenance

David A. Kuemmel
Winter Maintenance

Issam A. Minkarah
Sealants and Fillers for Joints and Cracks

James S. Moulthrop
Pavement Maintenance

William R. Reilly
Highway Capacity and Quality of Service

Roger Roess
Highway Capacity and Quality of Service

System Users

John W. Billheimer
Motorcycles and Mopeds

Richard Dowling (*left*), chair of the Highway Capacity and Quality of Service Committee, and Operations Section Chair Daniel Turner (*right*) flank newly named emeritus member William Reilly, Catalina Engineering, Inc.

Ronald Eck (*center*), West Virginia University, expresses his gratitude after receiving emeritus membership in the Low-Volume Roads Committee.

Ezra Hauer
Safety Data, Analysis, and Evaluation

John H. Lacey
Alcohol, Other Drugs, and Transportation

A. James McKnight
Motorcycles and Mopeds

Alison Smiley
Vehicle User Characteristics

Jerry A. Wachtel
Simulation and Measurement of Vehicle and Operator Performance

Marcus Ramsay Wigan
Bicycle Transportation

Gary L. Winn
Motorcycles and Mopeds

John J. Zogby
Transportation Safety Management

Helmut T. Zwahlen
Vehicle User Characteristics

Public Transportation

John Dockendorf
Bus Transit Systems

Edward S. Neumann
New Public Transportation Systems and Technology

Rail

George Haikalis
Intercity Rail Passenger Systems

Freight Systems

Anne Strauss-Wieder
Freight Transportation Planning and Logistics

Impressions of a First-Time Attendee

JOHN D. BELL

On the afternoon of December 15, 2004, I heard three wonderful words: "You've been approved." My employer, the New York State Department of Transportation (DOT), had agreed to send me to my first TRB annual meeting in a 22-year career. This was perhaps the best year for me to attend the meeting. In the past several months, I had become more involved in TRB activities, through participation on a National Cooperative Highway Research Program project panel and selection to a standing committee. I also was in the early stages of cosponsoring a research proposal. Moreover, New York State DOT Commissioner Joseph Boardman would take office as the next chair of the TRB Executive Committee during the meeting.

I arrived on the afternoon of Saturday, January 8, to ensure that I wouldn't miss any sessions. After registering for the meeting at the Marriott Wardman Park Hotel, I promptly attached to my name tag the white ribbon that signifies new attendee. That way, if I did or said anything foolish, people might give me the benefit of the doubt—a strategy that paid off more than once!

I quickly realized that annual meeting attendees maximize their time when I saw the crowded hotel gym at 6:30 a.m., likely the only free time all day. Their dedication was further validated by the standing-room-only attendance at the 8:30 a.m. session. For the next 4 days, I was amazed by the scale and complexity of the annual meeting, as well as by the quality of presentations, the caliber of speakers, and the resourcefulness of the TRB staff who keep the mega event running smoothly. Just as impressive was the participants' collective knowledge of a broad spectrum of transportation specialties and issues.

Because my work at New York State DOT focuses on freight transportation and economic development projects, I was primarily interested in sessions on the transportation of freight by rail and maritime modes. The selection of interesting and beneficial sessions on the topic was vast, but I could not possibly attend all, so I had to make many difficult choices.

All of the sessions I attended were outstanding. The material presented was visually and intellectually engaging; it routinely yielded more questions than time allowed; and it spurred additional post-session inquiries, discussions, and analyses.

One of the most worthwhile sessions was Session 127, Innovations in Project Delivery and Financing for Surface Transportation Infrastructure. The all-day Sunday workshop provided a thorough and thought-provoking discussion of public–private partnerships (PPP). I gained insight on what is needed to ensure a successful PPP and what federal programs and resources are available to support continued and expanded use. A highlight on Monday was Session 283, Transportation from the Customer's Perspective: Mega-Trends in Delivering the Goods. The session provided the carrier, federal, and state perspectives on transporting freight internationally.

Committee meetings also proved to be rewarding. On Monday, I received my first committee assignment from the International Trade and Transportation

Meeting authors at poster sessions.

The author is Section Head, Freight and Economic Development Division, New York State Department of Transportation.

Participating in committee meetings

Committee. Later that evening, at the Intercity Rail Passenger Systems Committee meeting, Randy Wade of Wisconsin DOT and I presented an overview of our joint research proposal for improved methods of rail preservation cost allocation for shared-use rail systems. The presentation was repeated on Tuesday at the Freight Transportation Economics and Regulations Committee meeting and on Wednesday at the Local and Regional Rail Freight Transport Committee meeting. The level of interest and support from these three committees was gratifying.

Although at times overwhelmed and disoriented by the scope of the event, I attended or participated in nearly everything I had scheduled. The annual meeting planning tool on TRB's website was particularly helpful in prioritizing my meetings and sessions.

What I would do differently next time is read more of the papers on the Compendium of Papers CD-ROM before the presentations. I also would spend more time at poster sessions, because they allow for personal discussions with authors. Finally, I would visit more exhibits to obtain the valuable documents, software, and other information they make available.

Selecting an itinerary of technical sessions.

As outstanding as my first annual meeting was, future meetings could be even better. Attendees may benefit from advance copies of PowerPoint presentations from sessions, either in hard copy or electronic files. This would allow challenged note takers—like myself—to focus more attention on listening to key points, instead of trying to copy down detailed information, such as tables and charts.

Attending my first annual meeting certainly rates as one of the formative experiences of my career. Perhaps if I had attended a meeting earlier in my career, the effect could have been greater. TRB is increasing efforts to involve younger professionals and graduate students in annual meeting activities. For employees of government agencies and private-sector firms with tightening travel budgets, expanded use and development of Internet e-sessions could lessen the impact of missing the meeting. TRB already posts some e-sessions online with real-time audio and PowerPoint presentations. Perhaps in the future, the staff can incorporate streaming video, too.

In conclusion, my first TRB annual meeting was highly worthwhile. I look forward to the privilege of attending and participating in future meetings.

Mark Norman, Technical Activities Director, responds:

TRB thanks John Bell for these impressions of a first-time attendee. His suggestions and those we have received from others for future improvements are being considered by the organizers of the TRB Annual Meeting. According to a February 2005 survey of annual meeting attendees, 91 percent of the more than 2,000 respondents rated the meeting as good to excellent, with only 1 percent ranking the meeting as fair or poor. We have already identified scores of improvements that will be implemented for the 2006 Annual Meeting as we strive to continuously improve the experience for first timers and veterans alike.

State Engineers Click on Traffic Calming Projects

The Minnesota Local Road Research Board (LRRB) launched a website in December 2004 to disseminate information on traffic calming techniques that have been implemented in the state. LRRB developed the site after concerns were raised that traffic calming projects successfully implemented in other areas of the country may not be effective in Minnesota because of climate challenges to installation and maintenance.

The site provides a searchable database of state traffic calming projects that attempt to reduce traffic speeds and cut-through traffic volumes. Most projects use engineering techniques that structurally modify the roadway environment either to prohibit certain vehicular movements or to encourage vehicles to drive at reduced speeds. The site also presents several strategies for implementing public education and enforcement campaigns to change driver attitudes and behavior.

In addition, the website includes recommended data collection guidelines to help standardize data, information about how different roadway classifications affect implementation, a list of previous LRRB-funded research related to traffic calming, and links to other related resources.

For more information, go to http://mn-traffic-calming.org.

INTERNATIONAL NEWS

School Bus Stop Lights Up for Safety

Drivers reduced speeds when schoolchildren waited at a bus stop fitted with flashing and running lights, according to results from a pilot study conducted by the Swedish National Road and Transport Research Institute (VTI). VTI researchers noted that the bus stop concept could improve the safety of children waiting for, entering, or exiting a school bus.

VTI designed the bus stop to improve the visibility of children to school bus drivers and other road users, who would decrease speed and move away from the curb where the children were waiting. Researchers found no current bus stop system that used dynamic or variable signs, but movable bus stops yielded positive results. Previous studies showed that variable running lights catch the attention of drivers better than static lights and do not cause risky driving behavior.

To achieve high acceptance of the system, children were provided with radio transmitters that activated the flashing and running lights when they came within 50 meters (164 feet) of the bus stop. The flashing lights alerted road users to drive with caution because children were at the bus stop. Conversely, inactive lights signified to drivers that no children were nearby.

VTI conducted a 4-week trial to test the effects of different bus stop elements on driver behavior. In the first week, children waited by the side of the road without a movable bus stop, sign, or flashing and running lights. In the second week, the movable bus stop and sign were set up.

In the third week, the bus stop also included the flashing and running lights, which children could activate with a radio transmitter. In the fourth week, the lights were taken down.

Driver speeds were measured by radar at three points along the road, 250 meters (820 feet) apart, and lateral lane positions were measured in front of the bus stop. Researchers also conducted phone interviews with road users.

The results of the trial demonstrated that the bus stop caused drivers to reduce speed, particularly in the lane closest to the bus stop. The average speed for vehicles that passed the bus stop in the adjacent lane was 88.5 km/h (55 mph) during Week 1, 76.2 km/h (47 mph) during Week 2, 67.2 km/h (41 mph) during Week 3, and 76.9 km/h (48 mph) during Week 4.

Drivers reduced speeds by 14 mph between the first week, when there was no bus stop, and the third week, when the flashing and running lights were activated. Furthermore, increased speeds between weeks 3 and 4 demonstrated that the flashing and running lights had a positive effect on driver behavior.

In addition, drivers improved lateral lane positions between Weeks 2 and 3 and Weeks 3 and 4. These results were not found for cars passing on the opposite side of the road. Data were analyzed only for morning bus stop activity, because children did not tend to remain at the bus stop for a long enough time in the afternoon.

Children, parents, and drivers had high acceptance of the system, including the use of the radio transmitters. Researchers acknowledged several questions about the long-term benefits of the bus stop concept, including whether it is justifiable to demand that children or parents carry the radio transmitters and how drivers would react to the system over a long period.

To read the report summary in English, go to http://62.119.60.67/EPiBrowser/Publikationer/English/R494.pdf.

Flashing lights at a school bus stop caused drivers to slow down during a pilot study in Sweden.

Konstadinos G. Goulias

University of California at Santa Barbara

To Konstadinos G. Goulias, human behavior is a key consideration in designing transportation infrastructure and services to meet the needs for accessibility and mobility. In his 18-year career in transportation planning, he has conducted basic and applied research to develop analytical tools that forecast the demand for transportation services, as well as simulation methods that examine the impacts of transportation policy decisions.

"Since transportation systems are the backbone connecting the vital parts of a city or a region, in-depth understanding of human nature is essential for the future development, growth, and management of the built environment," he explains. "Research offers new models of behavior that take into account environmental constraints and decisions made by individuals, households, and their organizations."

"Understanding human nature is essential for the development, growth, and management of the built environment."

Goulias is a professor in the Department of Geography, University of California (UC) at Santa Barbara. Since joining the university in 2004, Goulias has developed estimation methods and a computer code for data analysis, along with simulation systems for nationwide demographic and travel demand forecasting. These systems use dynamic econometric models of traveler behavior and microanalytic stochastic simulation methods.

A native of Greece, Goulias received a doctoral degree in civil engineering in 1991 from UC–Davis. He joined the engineering faculty at Pennsylvania State University, where he was appointed full professor in 2002. Goulias served as director of the Center for Intelligent Transportation Systems and the Transportation Operations Program at the Pennsylvania Transportation Institute from 1997 to 2004. As regional consortium director of the Mid-Atlantic Universities Transportation Center from 2002 to 2004, he directed and coordinated research into advanced technologies and management techniques that benefit transportation systems.

Goulias has focused his research in six areas: the dynamics of traveler behavior, computerized decision-making tools, intelligent transportation systems, e-commerce, sustainable transportation, and the optimal allocation of resources.

He has designed demand forecasting tools to analyze data from the first U.S. general-purpose transportation panel survey. Goulias initiated a research program called Longitudinal Integrated Forecasting Environment, which develops models of panel attrition, relocation, activity participation, and household time allocation to explain and predict the dynamics of human behavior.

Goulias also has produced a variety of decision support methods and systems for state, federal, and international agencies in transportation planning. One product, the Access Management Impact Simulation, identifies local and regional impacts of new developments using geographic information systems in combination with regional and local traffic simulation tools. His research contributed to significant portions of Pennsylvania's long-range transportation plan that address such issues as telecommuting and land use.

In his study of the interaction between information, technology, telecommunications, and transportation systems, Goulias has developed a methodology for the design of intelligent transportation systems, employing contextual theories of human behavior and methods to evaluate the effectiveness of operational systems. He has evaluated the advanced traveler information system of the Pennsylvania Turnpike Commission.

In addition, Goulias and his colleagues produced conceptual frameworks and models to study the impact of information and communications technologies on passenger and freight transportation. Key products include a framework for studying grocery teleshopping and a series of papers analyzing the effects of mobile information technologies on the travel behavior of households.

In sustainable transportation research, Goulias has evaluated the California Low Emission Vehicle program, assessed western Australia's method for conducting direct marketing to effect travel behavior change, and performed a market analysis for a hybrid-electric vehicle manufacturer in Portugal.

Goulias urges academics and practitioners to accelerate the assimilation of research findings into public policy by designing new tools and disseminating information about principles, theories, methods, models, data, information, and applications.

"Academics must reconcile the philosophies and approaches in the disciplines of engineering, economics, geography, anthropology, sociology, and psychology, so that the different perspectives can form a comprehensive understanding of people, groups, and interactions with the natural and built environment," Goulias contends. "A shift like this will have a profound, positive influence on infrastructure and service design, which can help us design transportation systems that are not only sustainable but also green and closer to the needs of users."

Active in TRB since 1987, Goulias is the founder and chair of the Task Force on Moving Activity-Based Approaches to Practice and is the immediate past chair of the Traveler Behavior and Values Committee. Author of more than 100 papers and 50 research reports, Goulias serves on the editorial advisory boards of two journals and regularly reviews papers for five journals.

Mary Lou Ralls

Ralls Newman, LLC

Mary Lou Ralls has dedicated her 20-year career in structural engineering to advancing the state of the practice in bridge design, construction, maintenance, and inspection. She has worked as an engineering consultant since retiring in 2004 from the Texas Department of Transportation (DOT), where she held several positions including bridge design, research, technology transfer, and policy. In addition, Ralls has served on several panels, task forces, and committees for the American Association of State Highway and Transportation Officials (AASHTO) and TRB. Throughout her career, she has recognized that research is the primary means of achieving advanced bridge technologies.

"One quarter of the nation's nearly 600,000 publicly owned bridges are classified as structurally deficient or functionally obsolete. Rehabilitating or replacing these bridges disrupts already congested highways," Ralls notes. "Prefabricated bridge systems can be rapidly installed to reduce traffic disruption and improve work zone safety. However, a strong structural research program is needed to further develop prefabricated systems that provide long-term performance with minimal maintenance."

"Structural research is needed to develop prefabricated bridges that provide long-term performance with minimal maintenance."

Ralls found a research ally in Texas, with its commitment to implement research products from the state universities. In conjunction with the Federal Highway Administration (FHWA), the state DOT has sponsored various bridge research projects to advance the state of the practice.

"If others had the vision of what's possible with an innovation, they would be already working to make the change," she contends. "The implementation of an innovation requires sustained effort by a champion."

Ralls earned a master of science degree in engineering in 1984 from the University of Texas (UT) at Austin. Her career in structural engineering began with her graduate work on an experimental research project to test a transversely posttensioned concrete bridge deck at UT's Ferguson Structural Engineering Laboratory.

After graduation, Ralls joined Texas DOT and became a licensed professional engineer in 1987. In the 1990s, she led efforts to develop the Texas U-beam, an open-topped trapezoidal-shaped pretensioned concrete beam that is an economical and aesthetic alternative to I-shaped beams. The U-beam is now used across Texas and in other states.

After 12 years as a bridge design engineer, Ralls spent a brief stint overseeing pretensioned concrete fabrication issues in the materials and tests division before becoming manager of the DOT's concrete and cement laboratories. She then joined the research office as a structural research engineer, managing the technology transfer group and a research implementation program.

In 1999, Ralls was appointed state bridge engineer and bridge division director. Under her management, the bridge division developed policy, standards, manuals, and guidelines for the design, construction, maintenance, and inspection of the state bridge system. The division also administered the federal bridge funding and safety inspection programs for the approximately 49,000 on- and off-system bridges in Texas.

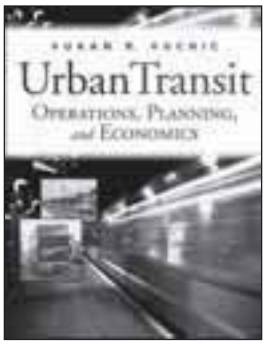
Ralls served as project director or adviser on several bridge research projects and participated on research management and oversight committees at the state DOT. She was the Texas representative on the AASHTO Strategic Highway Research Program Lead States Team for High-Performance Concrete in the 1990s, and she spearheaded the early use of high-performance concrete in bridge construction in the state.

Ralls led the prefabricated bridges initiative in Texas, and in 2001 she was named chair of the AASHTO Technology Implementation Group's Implementation Panel on Prefabricated Bridge Elements and Systems. The panel developed two brochures, a video CD, and web pages to promote the benefits of prefabricated bridges, including reduced traffic and environmental disruption; improved work zone safety, constructability, and quality; and reduced life-cycle costs.

She served as the state's voting member on the AASHTO Highway Subcommittee on Bridges and Structures (HSCOBS) and became the first chair of the AASHTO HSCOBS Technical Committee for Security in 2003. She also served as the AASHTO cochair on an international scan tour of prefabricated bridge elements and systems in Japan, the Netherlands, Belgium, Germany, and France in April 2004. Ralls is working with the scan team to implement the recommended technologies in the United States.

Active in TRB since 1996, Ralls has participated on several National Cooperative Highway Research Program (NCHRP) projects. She chaired the NCHRP Future Strategic Highway Research Program panel that examined the planning of research to accelerate the renewal of U.S. highways. She chaired the Concrete Bridges Committee from 1998 to 2003, when she was appointed chair of the Structures Section in the Design and Construction Group of TRB's Technical Activities Division. Ralls is chairing the National Research Council Committee for TRB's 6th International Bridge Engineering Conference, to be held in Boston in July.

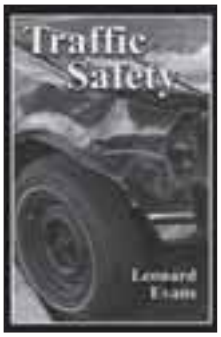
Urban Transit: Operations, Planning, and Economics



Vukan Vuchic. John Wiley & Sons, New Jersey, 2005; 664 pp.; $120 hardcover; 0-471-63265-1.

Longtime TRB affiliate and current member of the TRB Intermodal Transfer Facilities Committee, author Vukan Vuchic, University of Pennsylvania, presents theoretical concepts and practical methodologies for operations, planning, and analyses of transit systems. End-of-the-chapter exercises familiarize readers with the formulae and analytical techniques presented in the book's three sections: Transit System Operations and Networks; Transit Agency Operations, Economics, and Organization; and Transit System Planning.

Traffic Safety



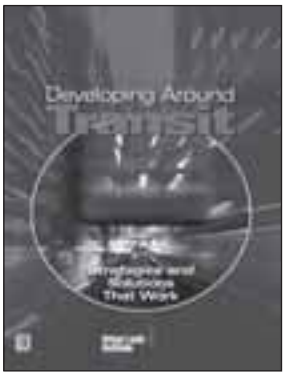
Leonard Evans. Science Serving Society, Michigan, 2004; 445 pp.; $99.50 hardcover; 0-9754871-0-8.

Author of the 1991 *Traffic Safety and the Driver*, Leonard Evans provides new research results and updates of earlier studies, together with surveys and syntheses of international literature, to examine traffic crash deaths, injuries, and property damage. Results are derived from many scientific disciplines, including psychology, sociology, medicine, epidemiology, criminology, biomechanics, economics, physics, and engineering. In a comparison of traffic safety performance measures in different countries, Evans concludes that 200,000 fewer Americans would have been killed between 1979 and 2002 if the United States had matched safety progress in Canada, Britain, and Australia. The author is a member of the NCHRP Panel on Applying Roundabouts in the United States.

Developing Around Transit: Strategies and Solutions That Work

Robert Dunphy, Robert Cervero, Fred Dock, Maureen McAvey, and Douglas Porter. Urban Land Institute, Washington, D.C., 2004; 183 pp.; $69.95; 0-87420-917-X.

Written by a team of experts in development, planning, and transit, the book presents strategies for developing districts around transit stations to revitalize deteriorating neighborhoods, provide more customers for transit, justify the transit investment, and raise property values. The strategies go beyond the typical formula of a master-planned mix of retail, offices, and housing, to incorporate ten key principles. *Developing Around Transit* examines ways to make transit districts pedestrian-friendly; describes objectives of developers, transit agencies, and other government bodies; includes research on benefits to property values; and provides differing approaches for urban and suburban areas.



Principal author Dunphy and contributing author Douglas Porter are members of the Transportation and Land Development Committee; Frederick Dock is a member of the NCHRP Project Panel on Alternatives to Design Speed for Selection of Roadway Design Criteria.

America's National Park Roads and Parkways: Drawings from the Historic American Engineering Record

Edited by Timothy Davis, Todd Croteau, and Christopher Marston. Johns Hopkins University Press, Maryland, 2004; 381 pp.; $55 hardcover; 0-8018-7878-0.

Authors examine 31 national park projects, highlighting characteristics of park road systems and explaining how roads affect visitor perceptions. The book presents 331 measured and interpretive drawings commissioned by the Historic American Engineering Record, a division of the National Park Service, to illustrate the physical characteristics, design strategies, construction practices, and visitor experiences of roads in national parks. Also included are non–Park Service projects that have relied on similar design strategies.

The books in this section are not TRB publications. To order, contact the publisher listed.

TRB PUBLICATIONS

Freeway Operations and Traffic Signal Systems 2004
Transportation Research Record 1867
Several algorithms are discussed: one that estimates speed from traffic surveillance cameras in a variety of traffic, weather, and lighting conditions; one that identifies bottleneck locations, the active times, and the delays that are caused; and others that are applied to the archived loop detector data in the I-4 data warehouse.

2004; 242 pp.; TRB affiliates, $42; nonaffiliates, $56. Subscriber category: highway operations, capacity, and traffic control (IVA).

Soil Mechanics 2004
Transportation Research Record 1868
This three-part volume covers soil stabilization, in papers on laboratory evaluation of mixing energy and its influence on soil–cement strength and on hydrated lime stabilization of sulfate-bearing Vertisols in Texas; geo-instrumentation, in papers on development of a wireless monitoring system for pile driving and on stress and strain monitoring of reinforced soil test walls; and geotechnical aspects of embankments, pavements, and foundations, in papers on design of short aggregate piers to support highway embankments and on lateral load behavior of cast-in-drilled-hole piles in weakly cemented sand.

2004; 204 pp.; TRB affiliates, $40.50; nonaffiliates, $54. Subscriber category: soils, geology, and foundations (IIIA).

Pavement Rehabilitation, Strength and Deformation Characteristics, and Surface Properties 2004
Transportation Research Record 1869
This three-part volume explores pavement rehabilitation, with papers on the long-term performance of broken and seated pavements and on evaluating potential for reflection cracking with rolling dynamic deflectometers; pavement strength and deformation characteristics, with papers on stiffness estimates using portable deflectometers and on the impact of overlays on pavement rutting and their interactions with design and material quality; and pavement surface properties–vehicle interaction, with papers on models for pavement quality measures and a wavelength-related ride equation.

2004; 158 pp.; TRB affiliates, $37.50; nonaffiliates, $50. Subscriber category: pavement design, management, and performance (IIB).

Data and Information Technology
Transportation Research Record 1870
Two methods for developing commodity flow forecasts at a local level are described. The use of transit vehicles as probes for collecting travel time data for automobiles on urban corridors is examined. An overview is presented of the development of the pavement smoothness specifications for the Long-Term Pavement Performance program. In addition, spatial measurements of roadway network usage, extracted from remotely sensed data, are demonstrated.

2004; 169 pp.; TRB affiliates, 37.50; nonaffiliates, $50. Subscriber category: planning and administration (IA).

Water Transport
Transportation Research Record 1871
Economic foundations of the Ohio River Navigation Investment Model, the development of container barge services on small waterways, the role of technology in achieving environmental policy for maritime transportation systems, and inland sulfate deposition from marine emissions in North America are discussed.

2004; 54 pp.; TRB affiliates, 28.50; nonaffiliates, $38. Subscriber category: marine transportation (IX).

Sharing Information Between Public Safety and Transportation Agencies for Traffic Incident Management
NCHRP Report 520
This report presents lessons learned around the country on how public safety and transportation agencies share information for managing traffic incidents.

2004; 86 pp.; TRB affiliates, $16.50; nonaffiliates, $22. Subscriber category: highway operations, capacity, and traffic control (IVA).

Identification of Research Needs Related to Highway Runoff Management
NCHRP Report 521
Research needs for the management and control of highway water runoff are analyzed in the context of findings from a survey of state transportation departments.

2004; 165 pp.; TRB affiliates, $18.75; TRB nonaffiliates, $25. Subscriber categories: planning and administration (IA); energy and environment (IB); highway and facility design (IIA); pavement design, management and performance (IIB); bridges, other structures, and hydraulics and hydrology (IIC); maintenance (IIIC).

TRB PUBLICATIONS *(continued)*

A Review of DOT Compliance with GASB 34 Requirements
NCHRP Report 522
The Governmental Accounting Standards Board (GASB) Statement No. 34 requires that the comprehensive financial statements of state and local governments include related depreciation or preservation costs in reporting general infrastructure assets. This report documents the various approaches taken by member departments of the American Association of State Highway and Transportation Officials to comply with the requirements of GASB 34 in the first year.

2004; 49 pp.; TRB affiliates, $14.25; nonaffiliates, $19. Subscriber category: planning and administration (IA).

Optimal Timing of Pavement Preventive Maintenance Treatment Applications
NCHRP Report 523
A methodology for determining the optimal timing to apply preventive maintenance treatments to flexible and rigid pavements is described. The methodology is incorporated into a software tool, *OPTime*, which is available for downloading on the NCHRP website.

2004; 76 pp.; TRB affiliates, $15.75; TRB nonaffiliates, $21. Subscriber category: maintenance (IIIC).

Cost-Effective Practices for Off-System and Local Interest Bridges
NCHRP Synthesis 327
Cost-effective practices and options for the repair, rehabilitation, strengthening, and replacement of local or off-system bridges are identified. Management and funding challenges also are discussed.

2004; 130 pp.; TRB affiliates, $15; nonaffiliates, $20. Subscriber category: bridges, other structures, hydraulics and hydrology (IIC).

Integrating Tourism and Recreation Travel with Transportation Planning and Project Delivery
NCHRP Synthesis 329
How well and how often are tourism and recreational travel included in transportation planning and decision making? This synthesis describes current practice, assembling selected case studies and survey information on the types of agencies involved in tourism, recreation, and transportation planning; agency priorities and concerns; multi-agency coordination; funding and implementation; data analysis and evaluation; and successful planning and project delivery.

2004; 53 pp.; TRB affiliates, $11.25; nonaffiliates, $15. Subscriber category: planning and administration (IA).

e-Transit: Electronic Business Strategies for Public Transportation—Concept for an e-Transit Reference Enterprise Architecture
TCRP Report 84, Volume 5
Systems engineering procedures and enterprise architecture concepts are summarized, including an approach used in the development of an architecture reference model for a transit agency.

2004; 41 pp.; TRB affiliates, $14.25; TRB nonaffiliates, $19. Subscriber categories: planning and administration (IA); public transit (VI).

Public Transportation Operating Agencies as Employers of Choice
TCRP Report 103
Principles and techniques are presented for use in workforce recruitment, development, and retention. The report includes a toolkit on CD-ROM (CRP-CD-45), a resource for strategies and solutions in positioning public transportation operating agencies as employers of choice.

2004; 12 pp. and CD; TRB affiliates, $21; nonaffiliates, $28. Subscriber category: public transit (VI).

Public Transportation Board Effectiveness: A Self-Assessment Handbook
TCRP Report 104
A self-assessment process and tools to measure the effectiveness of a public transportation board are provided in this report, which also includes references on how to change the characteristics of a board to improve effectiveness.

2004; 37 pp.; TRB affiliates, $14.25; nonaffiliates, $19. Subscriber categories: planning and administration (IA); public transit (VI).

Operational Experiences with Flexible Transit Services
TCRP Synthesis 53
This synthesis presents the experiences of transit operators with fixed-route or flexible transit services that are not purely demand-responsive. The book examines services in operation, ridership markets, ridership threshold levels, costs and funding, operating procedures and technology, design factors and criteria, training, marketing, and successes and failures. Six types of service are analyzed: request stops, flexible-route segments, route deviation, point deviation, zone routes, and demand-responsive connector service.

2004; 57 pp; TRB affiliates, $12; nonaffiliates, $16. Subscriber category: public transit (VI).

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School Travel Safety: Addressing Concerns

Each year approximately 800 school-age children are killed in motor vehicle crashes during school travel hours. This figure represents about 14 percent of the 5,600 child deaths that occur annually on U.S. roadways and 2 percent of the nation's yearly total of more than 40,000 motor vehicle deaths. Of these 800 deaths, about 20 (2 percent)—5 school bus passengers and 15 pedestrians—are school bus–related. Children driving or riding in passenger vehicles, pedestrians, bicyclists, and motorcyclists account for the other 98 percent of school-aged deaths. A disproportionate share of the passenger vehicle–related deaths occurs when a teenager is driving—about 55 percent.

TRB has examined a variety of issues related to the risks of children traveling to and from school, producing a bookshelf of knowledge to inform transportation professionals, decision makers, and members of the general public interested in pupil transportation policies and programs. Here are some of the titles published by TRB and the National Academies:

Operational Differences and Similarities Among the Motorcoach, School Bus, and Trucking Industries
Commercial Truck and Bus Safety Synthesis Program Synthesis 6, ISBN 0-309-08821-6, 47 pages, 8.5 x 11, paperback, $15 (2005)

A Guide for Reducing Collisions Involving Pedestrians
National Cooperative Highway Research Program (NCHRP) Report 500, Vol. 10, ISBN 0-309-08760-0, 133 pages, 8.5 x 11, paperback, $24 (2004)

Reducing Underage Drinking: A Collective Responsibility
National Academies Press, ISBN 0-309-08935-2, 760 pages, 6 x 9, hardback, $44.95 (2004)

Roadway Safety Tools for Local Agencies
NCHRP Synthesis 321, ISBN 0-309-06968-8, 168 pages, 8.5 x 11, paperback, $20.00 (2003)

Pedestrians and Bicycles 2003
Transportation Research Record: Journal of the Transportation Research Board, No. 1828, ISBN 0-309-08561-6, 132 pages, 8.5 x 11, paperback, $46.00 (2003)

The Relative Risks of School Travel: A National Perspective and Guidance for Local Community Risk Assessment
TRB Special Report 269, ISBN 0-309-07728-1, 170 pages, 6 x 9, paperback, $22.00 (2002)

Improving School Bus Safety
TRB Special Report 222, ISBN 0-309-04716-1, 214 pages, 6 x 9, paperback, $22.00 (1989)

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