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TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

TR NEWS

Demographic Changes Driving Change

Ensuring Mobility for All—Safely, Efficiently, Equitably

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TR NEWS

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DEMOGRAPHIC CHANGES DRIVING CHANGE

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COVER: Demographic changes bring changes in travel needs and preferences—researchers are studying the trends to prepare for adjustments to transportation systems and services. (Photo: John A. Rizzo, Getty Images)

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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ALSO IN THIS ISSUE:

CORRECTION: In the article, Nontoll Forms of Pricing to Reduce Traffic Congestion and Pollution: Mileage, Insurance, Carsharing, and Parking Strategies, by Allen Greenberg (*TR News*, July–August 2009, pages 28–31), an editorial error changed a per-mile fee from 0.43 cent to 43 cents. The sentence starting at the bottom of page 38 should have read, "In a second phase, the per-mile fee varied by location and traffic conditions—10 cents per mile within identified congestion zones and 0.43 cent per mile otherwise."

COMING NEXT ISSUE

Anatomy of Change in Winter Maintenance is the theme of the November–December 2009 *TR News*, assembling articles on weather and road condition forecasting, winter maintenance decision support systems, training for winter maintenance operations, data collection for roadway treatment delivery, new snow fence technologies, Sweden's real-time traffic management communications, Japan's use of cell phones for road and weather alerts, the chronology of an avalanche event on a highway in the Tetons, selecting snow and ice control chemicals to minimize environmental impacts, and more.

A Missouri Department of Transportation TowPlow, or trailer plow, can clear a path that can be adjusted from 10- to 26-ft wide with one operator and can allow a gang plowing operation to release two trucks to clear other routes.

INTRODUCTION

Changing Demographics Change the Transportation System

JOSEPH F. COUGHLIN, ROBIN KLINE, AND KATHERINE F. TURNBULL

The face of the United States of America is undergoing change. The population is more ethnically diverse, is getting older, and is increasing in numbers. These trends are forecast to continue. The U.S. Census Bureau projects that the nation's population will grow to 438 million by 2050, a nearly 43 percent increase from today's population of approximately 307 million. The Census Bureau estimates that 80 percent of this increase will come from immigrants and their descendants.

At the same time, more Americans are living in megaregions; telecommuting and alternative work arrangements are gaining adoption; and one-person households are increasing. With dynamic changes in national and global economic activity, uncertainty about the availability and cost of energy, and rapid advances in technology, a different picture emerges of the United States in 2050.

All of these factors have significant implications for the transportation system. The sociodemographic and economic characteristics of the population influence transportation demand for different modes. Age, income, gender, ethnicity, household size, and automobile availability are some of the variables that influence travel behavior. Providing safe mobility for the aging baby boom generation, for a more ethnically diverse population, and for a larger population is critical for the nation's economic vitality and quality of life.

The Transportation Research Board (TRB) is at the forefront of examining the potential impacts of demographic changes on the transportation system. TRB technical standing committees are sponsoring specialty conferences, workshops, and Annual Meeting sessions on a range of related topics. Committees also are developing research problem statements and are assisting in the dissemination of results from current studies. TRB's National Cooperative Highway Research Program is launching a major research project on the effects of sociodemographics on travel behavior.

This issue of *TR News* highlights information presented at the 2008 conference on the Impact of Changing Demographics on the Transportation System, sponsored by the Research and Innovative Technology Administration of the U.S. Department of Transportation, and organized by TRB. Articles on the changing racial and ethnic mix and transportation, gender differences and transportation, aging and transportation, and the mobility and safety of older women highlight current research. TRB continues to pursue activities to improve understanding—and to predict the influence—of sociodemographic changes on the transportation system.

The authors served on the Planning Team for the 2008 Impact of Changing Demographics on the Transportation System Conference, chaired by Coughlin, who is Director of the New England University Transportation Center and AgeLab at the Massachusetts Institute of Technology, Cambridge. Kline is a University Program Specialist with the Research and Innovative Technology Administration, Washington, D.C. Executive Associate Director of the Texas Transportation Institute, College Station, Turnbull chairs the TRB Planning and Environment Group.

EDITOR'S NOTE: Appreciation is expressed to TRB Senior Program Officer Thomas R. Menzies, Jr., for his contributions in developing this issue of *TR News*.

Travel Demand in the Context of Growing Diversity

Considerations for Policy, Planning, and Forecasting

HEATHER CONTRINO AND NANCY McGUCKIN

Contrino is Travel Surveys Program Manager, Office of Highway Policy Information, Federal Highway Administration, Washington, D.C. McGuckin is a Travel Behavior Analyst in South Pasadena, California.

The United States is experiencing a period of change—the economy is struggling, fuel prices are erratic, environmental issues are prominent, roadway capacity has reached a peak in large urban areas, and demographics are undergoing major shifts. In the past five decades, changes in travel volumes and behavior have coincided with dramatic changes in the economy, culture, development patterns, and technology (*1*).

The growth in travel since the 1960s is a product of demographic and economic changes, including increases in vehicle ownership, the entrance of baby boomers—especially women—into the workforce, and growth in personal income (*2*). Recent data from the Highway Performance Monitoring System, Traffic Volume Trends, and preliminary results from the 2008 National Household Travel Survey, however, indicate that demand is slowing and occasionally declining.

Whether or not this is a continuing trend has yet to be determined, but the economic slowdown, an aging population, an influx of new immigrant groups, the saturation of vehicle ownership, concerns about the environment, and unpredictable fuel

Understanding the interaction of household size, automobile availability, and travel demand, and the differences and needs across specific population groups, is critical in assessing trends, the viability of programs, and the impacts of projects and policy.

PHOTO: U.S. CITIZENSHIP AND IMMIGRATION SERVICES

A naturalization ceremony at Mount Vernon, Virginia. According to the 2005 U.S. Census, immigrants make up about 12.1 percent of the country's population—the highest proportion in nearly 100 years. New immigrants' travel patterns differ at first from those of the U.S.-born population.

costs could have an impact on travel demand in the United States. Some of these phenomena may exert more influence than others, but the growing diversity of the U.S. population and changes in the social norms of travel play important roles in shaping travel demand.

Highway finance, congestion, land use planning, air quality, fuel costs, oil dependency, global warming, the virtual marketplace, and infrastructure investment are some of the issues challenging the performance and use of the U.S. transportation system (*3*). Understanding the people who travel—especially the differences in travel demand and the needs across specific population groups—is critical in assessing current and future trends, the viability of programs, and the impacts of projects and policy on system users.

Household Travel in Context

Household travel generates more than 80 percent of the total vehicle miles of travel in the United States; freight and commercial vehicles produce the remainder. Historically, when the rate of growth in travel exceeds the rate of population growth, several influences are at work, including the age distribution of the population, the levels of automobile ownership, licensure rates, household size, participation in the labor force, and real personal income per capita (*4*).

African-American, Hispanic, and—to some extent—Asian households vary from white households in terms of these key factors. Minority groups commonly have less ownership of automobiles, lower household income, greater household size, lower levels of participation in the labor force, lower rates of licensure, and a concentration of population in urban areas.

Population Growth and Age Distribution

The white population in the United States is projected to remain relatively stable over the next 40 years; the current minority groups will be the main contributors to population growth. The number of Hispanics is expected to grow by 188 percent; the Asian population to grow by 213 percent, and the black population—Hispanic and non-Hispanic—is expected to grow to 61.4 million in size (*4*).

Significantly larger percentages of African-Americans, 29.2 percent, and of Hispanics, 31.9 percent, are under the age of 16, compared with 20.6 percent of whites and 21.6 percent of Asians. Minority populations therefore will have an increasing influence on travel needs, preferences, volumes, and behavior in the future as they enter the workforce and start families (*3*).

PHOTO: DAN BURDEN

PHOTO: DAVID PARISI, PARISI ASSOCIATES TRANSPORTATION CONSULTING

Household travel—such as supermarket trips (*above*) and picking up children from school (*below*)—generates more than 80 percent of the total vehicle miles of travel in the United States.

Vehicle Availability and Licensure Rates

People in poorer households without a reliable vehicle, or with no vehicle at all, have a greatly reduced level of mobility. When they have vehicles, the vehicles are more likely to be older models, which often require more maintenance; moreover, the lower vehicle efficiency increases the cost of travel for the household.

A high percentage of African-American, Hispanic, and Asian households have no vehicle (Table 1). In

TABLE 1 Zero-Vehicle Households (*5*)

White	7.3%
African-American	23.8%
Hispanic	17.2%
Asian	12.7%
All	10.3%

PHOTO: AAA FOUNDATION FOR TRAFFIC SAFETY

Teens take a driver's education class. Driver licensure rates among African-American and Asian women are low compared with the rates for their male counterparts; licensure often is affected by cultural and economic factors.

the United States, 10.3 percent of all households have no vehicle; for African-American households, however, the rate is 23.8 percent and for Hispanic households, 17.2 percent. The availability of safe, alternative modes of travel will gain importance in transportation planning as these populations grow.

Licensure rates reveal age and gender differences. As shown in Table 2 (below), African-American and Asian women have very low rates of licensure compared with the rates for their male counterparts. Income constraints and cultural norms often influence licensing, especially for immigrant women, and must be considered when predicting the travel needs of minority populations (*5*).

TABLE 2 Gender, Race, and Licensure Rates (*5*)

	White	Black	Asian	Other
Male	91.8%	77.9%	87.2%	82.3%
Female	88.8%	72.0%	76.6%	70.3%
Total	90.2%	74.4%	81.9%	76.2%

Household Size and Travel Rates

The interaction of household size, automobile availability, and travel demand is fundamental. For example, Table 3 (below) shows that Hispanic households produce the greatest amount of travel annually—5,000 trips per household per year—but the number of trips per person is among the lowest. This is a result primarily of higher-than-average household size.

Hispanic households also have the highest vehicle occupancy at 1.8 persons per vehicle trip. A large influx of new immigrants, combined with lower levels of vehicle ownership, concentration in urban centers, larger households, and lower incomes, contributes to the car sharing that is common among Hispanic households—a unique characteristic of their travel behavior.

Mode Use

Blacks, Asians, and Hispanics are more frequent users of alternative modes of transportation than are whites (*6*). For example, Asians travel 6.5 times more

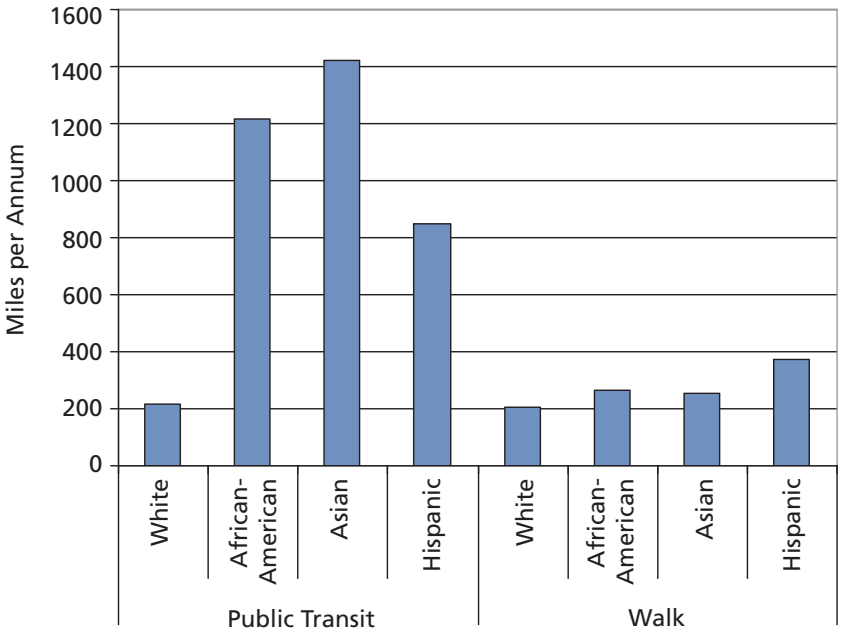
TABLE 3 Annual Trip Rates, Vehicle Ownership, and Vehicle Occupancy

	Trips per Household	Trips per Person	Vehicles per Household	Vehicle Occupancy
White Non-Hispanic	3,693.9	1,525.2	1.99	1.51
Black Non-Hispanic	3,609.5	1,318.9	1.38	1.55
Asian Non-Hispanic	3,868.6	1,342.5	1.74	1.58
Hispanic	4,979.5	1,327.9	1.69	1.80

Source: 2001 National Household Travel Survey, FHWA Office of Highway Policy Information

PHOTO: DAN BURDEN

Per person, Hispanics walk 75 percent more miles on average than all other ethnic groups.



Source: 2001 National Household Travel Survey, FHWA Office of Highway Policy Information

FIGURE 1 Annual miles traveled via transit and on foot.

miles on transit per person per year than whites do. Hispanics walk 75 percent more miles on average per person than all other groups. The differences in transit and walk miles per person per year are shown in Figure 1 (above right).

Time spent commuting is often considered an indicator of quality of life, because more time spent in travel takes away from other home activities. Commuting time is a function of distance, congestion on the route, and mode of transportation. Of all races and ethnic groups, whites are the least likely to spend more than 1 hour commuting to work; only 10.6 percent of blacks, 10.3 percent of Asians, and 9.1 percent of Hispanics have commuting times of 1 hour or less (Table 4, below).

Race, Ethnicity, and Immigration

In the United States, discussions of race and ethnicity often involve immigration. Although the recent economic downturn has slowed the pace of immigration, the U.S. Census showed in 2005 that an estimated 12.1 percent of the U.S. population were immigrants—the highest percentage since 1920 (Figure 2, page 8). This historic influx of new races, ethnicities, and cultures will have an impact on the demographic makeup of the U.S. population and on the distribution and characteristics of travel demand.

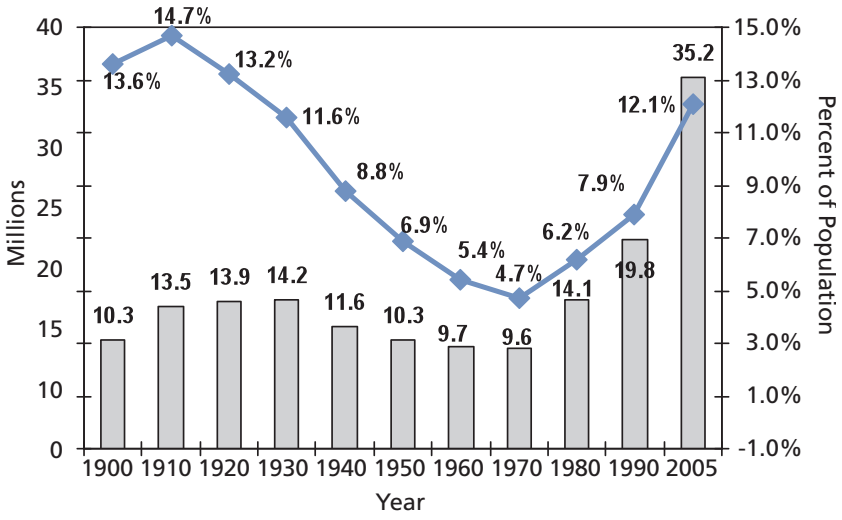
Policy and program plans therefore should incorporate an understanding of the different travel experiences, options, and needs of new immigrants. At first, immigrants travel differently from the population born in the United States, relying to a greater extent on transit, walking, and carpooling. As immigrants assimilate into society, their travel patterns assimilate and become more dependent on personal vehicles (*7–11*). Asian immigrants make a faster transition to automobile use than other immigrant groups. Even after 20 years as residents, however, Hispanic immigrants remain more likely to use transit than the population born in the United States; this may result from many factors, including lower automobile availability (Figure 3, page 8).

TABLE 4 Commuting Time, All Modes (*5*)

	<20 minutes	>60 minutes
Whites	48.3%	7.1%
African-Americans	39.0%	10.6%
Asians	38.6%	10.3%
Hispanics	44.0%	9.1%

PHOTO: TIM ADAMS, TRANSITPEOPLE

Two girls ride a Los Angeles bus. Blacks, Asians, and Hispanics are more frequent users of alternative modes of transportation than are whites.



Source: Decennial Census for 1990 to 2000, Center for Immigration Studies and Analysis of March 2005 Current Population Survey Data

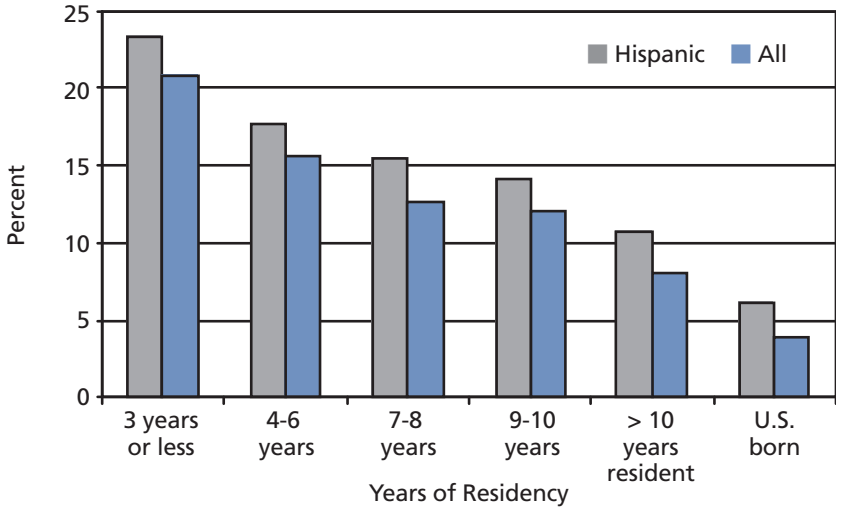
FIGURE 2 Immigrants in the United States, 1900–2005.

Prospects for the Future

The United States historically has been characterized as a melting pot, and if trends continue, current racial and ethnic minorities will fuel much of the future growth in travel demand. On average, minorities are more dependent on transit, have higher occupancy levels in automobiles, and have lower levels of vehicle ownership. Initiatives that focus on tolling, infrastructure development, land use planning, and highway finance can benefit from information about the travel behavior, options, and needs of minority groups.

Understanding the differences in travel behavior and the possible explanations for these differences can help in modeling travel demand, in finding the policies best suited for the travel needs of all population groups, and in addressing concerns about environmental justice (*12*). As U.S. society increases in diversity in the next few decades, a significant portion of growth in travel demand will come from minority populations. The differences in travel behavior have wide-reaching consequences for short- and long-term policy development, planning, and travel demand forecasting.

FIGURE 3 Immigrant households with zero vehicles, by years of U.S. residency.



Source: U.S. Census, Public Use Microdata Sample

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Preparing the Transportation System for Demographic Changes

Conference Explores Research Needs

KATHERINE F. TURNBULL

Approximately 110 researchers, practitioners, and policy makers gathered in Washington, D.C., in October 2008 to discuss the implications that a range of demographic changes may have for the U.S. transportation system. Supported by the U.S. Department of Transportation's Research and Innovative Technology Administration (RITA), organized by the Transportation Research Board (TRB), and oriented to university transportation centers, the Impact of Changing Demographics on the Transportation System Conference focused on the impact of four demographic forces on transportation over the next 20 years:

Heather Contrino, FHWA, speaks at a plenary session of the Impact of Changing Demographics on the Transportation System Conference, October 2008, at the Keck Center of the National Academies, Washington, D.C.; her subject was "Demographics Matters: Travel Demand, Options, and Characteristics Among Minority Populations."

- Aging and demographic transition,
- Immigration internally and from abroad,
- Changing racial and ethnic mix, and
- Gender differences.

The program featured keynote speakers, breakout sessions, and an interactive poster session on the effects of the four demographic forces on transportation system demand and on safe mobility. Speakers highlighted national trends and recent studies from urban and rural areas throughout the country.

During the discussion sessions, participants identified knowledge gaps and issues for research. One critical knowledge gap is the scarcity of data on key demographic and transportation characteristics. Developing and maintaining these data at the national and local levels emerged as a priority for researchers, public agencies, and policy makers.

The breakout groups extensively discussed the effects of the aging of the baby boom generation on the transportation system. The actions and activities of this age group will have significant impacts on housing and land use patterns, use of travel modes, and safety. Many research ideas were identified to track the travel behavior of baby boomers and the changes that develop in their behavior over time and to obtain information on boomers' preferences for housing, social services, and cultural and recreational amenities that can influence travel patterns.

Participants identified a variety of research needs to improve understanding of the relationship among family characteristics, age, social networks, and travel behavior in different population groups. The impacts of one-person households, nonwork travel, informal transportation services, and the driver safety risks associated with different groups were cited as other topics for further research.

Many participants favored a multidisciplinary approach in the research to address these and other questions. Several emphasized the need to provide elected and appointed officials with information to assist in decision making for public policy.

The conference proceedings will be released as a Transportation Research Circular on the TRB website; many presentations are posted online at http://onlinepubs.trb.org/onlinepubs/archive/conferences/2008/ImpactDemographics/pdf/Program.pdf.

The author is Executive Associate Director, Texas Transportation Institute, Texas A&M University, College Station, and Chair of the TRB Planning and Environment Group.

Changes in Travel Characteristics by Gender

U.S. Commuting Trends from a National Sample, 1985–2005

RANDALL CRANE

The author is Professor and Vice Chair, Urban Planning, and Associate Director, Institute of Transportation Studies, University of California, Los Angeles.

Researchers are fundamentally interested in how demographic characteristics are associated with different kinds of travel, travel modes, and travel outcomes. Do certain demographic characteristics generate more travel, or do they restrict travel—and what is the magnitude of these changes? Which demographic characteristics have the most and the least influence on transportation demand, and which are changing the most and the least?

Gender and the Commute

One topic for focus is the association between gender and the commute. The commute anchors many other travel purposes and is the basic tie between the labor and the housing markets. Female behaviors in both markets are changing more than those of males—taking stock of these trends for the purposes of transportation policy therefore is timely.

For several years, women's rates of participation in the workforce have gained on those of men. The literature nevertheless continues to document a gender gap in commuting distances and times, with men historically commuting farther and longer. The most popular explanation is that women traditionally have a greater share of home- and child-centered responsibilities. A second explanation notes the concentration of women in part-time and lower-wage jobs, which intuitively do not justify long commutes.

Both these in-home and out-of-home labor explanations are subject to change in changing times—although how the trends vary by place and by

PHOTO: DAN BURDEN

Women's travel is changing more than men's.

personal characteristics also matters. Yet women's increased participation in the workforce and their increased orientation to careers in their education and their work plans—a so-called "quiet revolution"—might be expected to reduce the gender gap for commutes. Recent data for San Francisco, California, and for Quebec City in Canada indicate that the gap is closing for some groups of men and women.

Data from a national survey that covers the past two decades also can be applied. Every 2 years, the Census Bureau conducts the American Housing Survey (AHS) for the U.S. Department of Housing and Urban Development. Residents of many of the same 50,000 housing structures, considered nationally representative, have been sampled for each survey since 1985, and details have been gathered on the individuals. This has produced cross-sectional data by year and a longitudinal panel over time. The AHS asks basic questions about the commute trip, including the mode used, the distance traveled, and the travel time. Some interesting trends emerge from the AHS commute data for 1985 to 2005.

Distances and Travel Time

The AHS data indicate that all commutes are lengthening on average, with travel distances increasing 1 percent per year, and travel times increasing at about half that rate. From 1985 to 2005, the commute distance for women increased by 30 percent, to 11.8 miles; and the commute distance for men increased by 22 percent, to 14.1 miles (Figure 1, below). This suggests that the gender gap for commute trip length is converging, although slowly.

The average travel time for a commute, however, increased slightly more for men than for women over the two decades recorded by the survey. The average travel time for women's commutes increased approximately 9 percent, to 21.1 minutes; the average travel time for men's commutes increased approximately 10 percent, to 23.5 minutes.

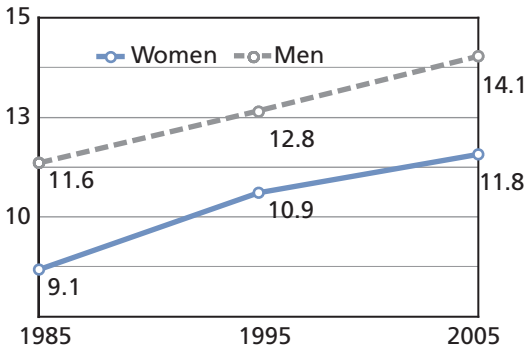

FIGURE 1 Commute distances for women and men, 1985–2005 (in miles).

PHOTO: LAURA SANDT

Women and a child waiting at a Portland, Oregon, bus stop. Travel times on public transit are similar for men and women.

Gender and Race

Differences between travelers cannot be reduced to gender only—the interactions of other demographic factors should be examined also and can prove critical over time. An examination of the growth in distance commuted in personal vehicles, by gender and race, reveals that the commute distance of white males changed little over the two decades, but commute distance for Hispanic women, black females, and Hispanic males increased. The details of these patterns remain understudied, and the factors that influence the patterns need more research.

The AHS data on mode use for one-way commute travel indicate that men and women have higher average travel times on public transit. The travel times by transit for men and women, however, are similar, suggesting less of a gender gap among transit riders than among commuters using personal vehicles.

Examining mode split by gender and race indicates that white males and females have low levels of transit use on commute trips. Blacks have the highest use of transit, yet from 1985 to 2005, use by black women declined dramatically, by approximately 50 percent. Transit use by black males also declined,

From 1985 to 2005, the use of transit by black women declined by approximately 50 percent.

The gap in men's and women's commute distances decreases for single-adult households with children but remains large for married-couple households with children and both parents working.

but not as sharply. More research is needed to examine these trends, especially the decline in the use of transit by black women.

Age and Family Type

Younger age groups have the smallest gender gap (Figure 2, below). The largest differences occur among men and women in the age group of 35 to 54 years old. Although the commute distance for women in that group declines, the decline was less in 2005 than it was in 1985.

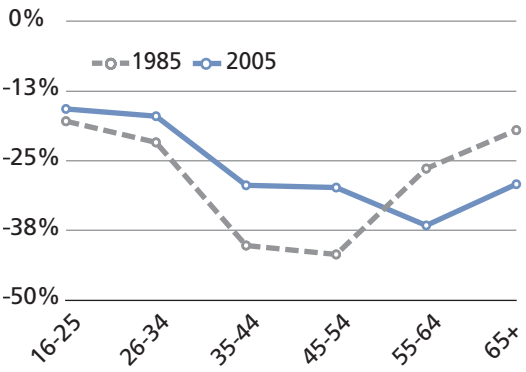

FIGURE 2 Women's commute distances as percent of men's, by age (via private vehicles).

In 1985, the smallest difference in male and female commute distances by family status was for heads of single-adult households with children; the largest gap was for married-couple households with children and both parents working. This trend is consistent with the economics of gender and of households.

The data also indicate that the gender gap increased for single-adult households with no children and for married-couple households with no children, but decreased in single-adult households with children and married-couple households with children. Working women in households with children are commuting farther than they had in the past, especially in comparison with the distances traveled by their spouses.

Marriage is associated with shorter commutes for women, but children are not an influencing factor statistically. Perhaps the presence of children increases the income needs of the household, which may result in women working farther away, even while their home-centered responsibilities remain. Better data and more study would clarify these relationships.

Substantial Differences

Gender has an influence on commuting patterns, but how this influence is changing with women's changing participation in the workforce is complicated. Although men continue to commute farther and somewhat longer, women are catching up. In particular, the commutes of married women with children are lengthening at a rate three times faster than that for the commutes of their working husbands. The gender gap is smallest for younger women, and this characteristic is carrying through as the cohort ages. The gap is most pronounced among whites, though the once-wide gap in mode availability and choice among white and minority women is quickly narrowing.

If women are traveling more like men, does this argue for a decreased focus on gender in transportation planning? No, because the differences are still substantial, especially when viewed in the context of other demographic factors. Men and women travel differently, and the variation in behaviors and circumstances linked to gender requires more detailed exploration.

The AHS data may be hinting that the continued rise of dual-earner families of more comparable earning levels is leading to longer commute trips and to less reliance on transit. More detailed results on these issues will be reported soon.

Focusing on Demographic Changes and the Transportation System

TRB Activities Under Way

KATHERINE F. TURNBULL

In addition to organizing the 2008 conference on the Impact of Changing Demographics on the Transportation System, the Transportation Research Board (TRB) has undertaken many other activities to improve understanding and to anticipate the influence of sociodemographic changes on the transportation system. These activities include other specialty conferences, sessions at the TRB Annual Meeting, committee efforts, and a National Cooperative Highway Research Program (NCHRP) project.

◆ **Other specialty conferences.** The TRB Women's Issues in Transportation Committee has sponsored four international conferences. The 2009 International Conference on Women's Issues in Transportation addressed a range of topics on women's travel needs and travel patterns—from driving to "fampooling" to bicycling to walking to riding the bus and even to racecar driving. Cosponsored by several federal, state, university, and international organizations, these conferences have become a focal point for the discussion of women's issues in transportation in the United States and other nations and for the advancement of needed research.

◆ **Annual Meeting sessions.** Sessions at TRB Annual Meetings have elevated the importance of identifying the impacts of sociodemographic changes on the transportation system. A session at the 2009 Annual Meeting highlighted presentations by key speakers at the Impact of Changing Demographics on the Transportation System Conference. The National Transportation Data Requirements and Programs Committee is sponsoring a workshop at the 2010 Annual Meeting on the results of the 2008 National Household Travel Survey and a session on the links among walking and bicycling, socioeconomics and demographics, and mobility and livability.

◆ **Committee activities.** TRB Technical Activities committees, sections, and groups are pursuing a variety of activities to advance the understanding of the impact of sociodemographic changes on travel behavior and the transportation system. The topic is one of the crosscutting issues taken up by the Policy and Organization Group. Data Section committees have several efforts under way to maximize use of the 2010 Census and related surveys. The Transportation Education and Training Committee has sponsored Annual Meeting workshops on the impact of sociodemographic changes on the transportation workforce.

◆ **NCHRP project.** NCHRP Project 20-83(06), Effects of Sociodemographics on Travel Demand, is starting up in spring 2010 to assess the possible effects of sociodemographic factors on travel demand over the next 50 years. The second objective is to identify strategies and actions to assist state departments of transportation and other agencies to plan and prepare for plausible future scenarios. The research will enhance understanding of the relationship between social, demographic, and economic factors and travel demand.

More information on these activities is available at www.TRB.org.

Key Issues in Transportation and Aging

Ensuring Safe Mobility for Older Adults

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During the past decade, research and educational efforts have focused on maintaining safe mobility for older adults—a recent book on the topic cites nearly 900 references (*1*). The attention is appropriate, yet the problems are far from solved. The populations of most Western nations are aging with the aging of the baby boomers, who are expected to bring a culture of "automobility" into older adulthood, holding onto licenses longer and driving more than previous cohorts.

Age-related medical conditions and the medications to treat these conditions, however, can make safe driving difficult for some older adults. Several recent studies have confirmed that as a group, adults 70 years old and older are at a higher risk for a fatal crash, and that crashes involving this age group tend to occur at times and places typically considered safe (*2*).

Driving cessation, however, has been linked to many negative outcomes, and nondriving mobility options are limited in most areas. Society therefore is facing a serious community mobility problem.

The many issues of aging and mobility have three complementary and interdependent goals (*1*):

- To understand and manage the effects of medical conditions and medications on the skills needed for safe driving;
- To help those who are able to drive safely continue to do so; and
- To identify and provide community mobility support to those who are no longer able to drive.

Medical Conditions and Driving Skills

Concerted research efforts have examined the relationship between older driver crash risk, specific medical conditions, and the medications used to treat them. Excluding vision-related problems, the research has not found strong links between medical

PHOTO: AAA FOUNDATION FOR TRAFFIC SAFETY

The aging baby boom generation is expected to continue driving longer and driving more than older adults in previous generations.

conditions and older adult crash risk (*1, 3, 4*).

Several researchers have pointed out the difficulties of linking crash risk with medical conditions, noting that crash risk is influenced by many factors. Not all medical conditions influence crash risk to the same degree, and individuals with the same condition differ greatly in how they are affected (*3*, *4*).

Individuals also vary in their approaches and resources to compensate for declining functional abilities. In addition, some chronic conditions may involve acute episodes, drastically increasing crash risk and complicating any judgments about fitness to drive.

Many chronic medical conditions are progressive, such as Parkinson's disease. A medical condition in its early stages may not affect driving safety but may compromise it at a later stage. Some older drivers may have comorbid medical conditions—that is, more than one—making it difficult to determine the specific condition that may influence driving performance and crash risk.

Similar difficulties arise in establishing the relationship between medication use and crash risk. Medications can impair driving for any age group, but medication use may have a greater effect on older drivers. Older people are more likely to use several medications, may not metabolize a medicinal compound quickly, and may experience adverse changes (*5*). Their use of medications also may be inappropriate—under- and overutilization of medications are common among older adults.

Older adults also frequently consume over-the-counter medications, herbal supplements, and alcohol along with their prescription medications. The medical conditions and the timing and strength of a dose can complicate the task of relating traffic crashes to medication use.

Reformulating the Problem

Researchers have begun to reformulate the problem, as shown in Figure 1 (*1, 6*). According to this model, all driver behavior is influenced by individual characteristics and functional abilities. Individual characteristics encompass a range of factors, including a driver's tolerance for risk, behavioral adaptations, preferences, personality, and driving history. Functional abilities refer to the perceptual, cognitive, and psychomotor abilities needed for everyday activities (*7*).

The interaction between medical conditions and the medications used in treatment—both the therapeutic effects and the side effects—have an impact on a driver's functional abilities. A driver's health conditions, treated or untreated, also influence functional abilities. Properly treated conditions can improve functioning, but untreated or mistreated

PHOTO: SULPHUR SPRINGS SENIOR CITIZENS CENTER, TEXAS

Researchers acknowledge difficulties in determining the effects of medical conditions and medications on crash risk—not all conditions influence crash risk to the same degree, and individuals with the same condition differ greatly in how they are affected.

conditions can have deleterious effects.

The levels of functional abilities affect the skills needed for safe driving. Individual characteristics and the ability to perform critical driving skills influence crash risk. This formulation does not require specific information about medical conditions or medications, but about the levels of functional abilities.

Continuing Safe Driving

Like most drivers, older people tend to prefer a personal automobile for their mobility needs; few satisfactory nondriving options are available in most locations. Five promising approaches for meeting this goal include driving evaluation, education and rehabilitation, vehicle design and modification, advanced technology, and roadway design.

Driving Evaluation

To help older adults continue to drive safely, knowing which drivers are at increased risk for a crash is critical. Driving evaluation consists of screening and assessment.

Screening is the first step, identifying potentially high-risk drivers by revealing major functional

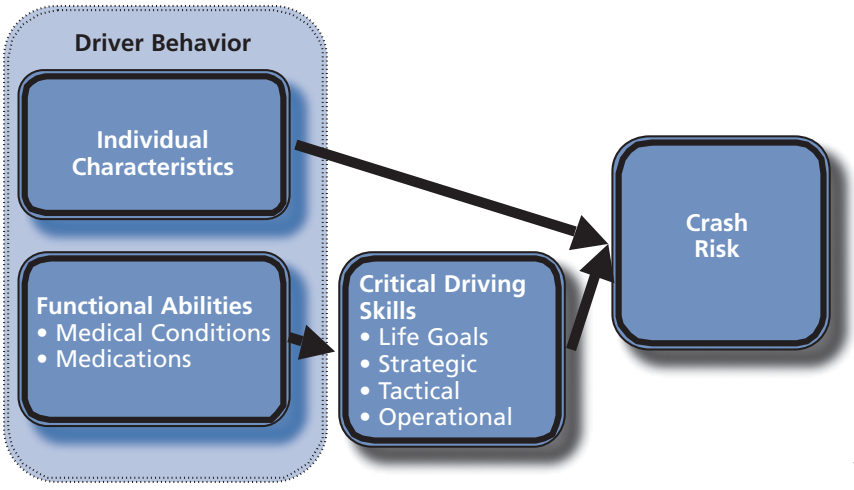

FIGURE 1 How medical conditions and medication can influence crash risk [adapted from Eby et al. (*1*)].

Driving simulators can be used to improve, refine, extend, and test driving skills.

impairments. Screening also can prompt an in-depth driving assessment but should not be used alone to determine driving fitness. Driver assessment is an in-depth, professional investigation to determine the level and cause of an observed impairment and is necessary to support decisions about whether someone should continue driving and under what conditions.

Screening and assessment contribute to a comprehensive, multidisciplinary approach for identifying older drivers who may be at risk. The driving evaluation can take place in the home or community, in a clinical setting, or at a licensing agency; each setting has unique issues.

Home and Community

The home and community are an ideal setting for driver screening. Many problems with driving are first identified by a family member, the driver, or a police officer. Self-screening tools are available for use by drivers; educational programs and materials help families screen and talk with their older adult members; and educational materials help police interact with older drivers. Few of these packages, however, have been evaluated, and none has been shown to improve traffic safety.

Programs such as CarFit, which helps seniors find a vehicle that fits their comfort level and driving ability, assist the older person in continuing to drive by focusing on individual capabilities.

Clinical Settings

Physicians and other health professionals can assess driving-related problems as part of general medical treatment and care. Identifying declines in functional abilities early on can facilitate opportunities for treatment and rehabilitation.

If clinical testing indicates that functional abilities have declined to the point of compromising driving safety, many older drivers will stop driving voluntarily at the advice of their physician (*8*). Many physicians, however, indicate that they are uncomfortable with making fitness-to-drive decisions and with reporting the decisions to licensing agencies. Physicians cite several reasons: without a test battery that predicts crash likelihood, they often lack the information necessary to make informed fitness-to-drive decisions; they do not want to breach physician–patient confidentiality; and they do not want to develop a reputation for reporting drivers, which could lead to a loss in patients; moreover, state laws on physician reporting and immunity are inconsistent.

Licensing Agencies

Licensing agencies can screen and assess for fitness to drive because older drivers must renew their licenses; the licensing agency has authority to deny or restrict a person's license to drive. Drivers' license renewal policies vary from state to state in terms of the renewal cycle, the requirements for accelerated renewal for older drivers, and other provisions. These policies are not based on empirical evidence, and many questions remain about an optimal policy.

In addition, licensing agencies must weigh practicality and cost, along with the potential benefits of agency screening and assessment. For example, conducting an in-depth assessment of every driver who reaches a certain age—as suggested by some advocates of age-based driver evaluation—would be impractical and expensive.

Educational Programs

Educational programs are available for older drivers but vary in scope, format, and content. Most programs focus on awareness of functional declines and what they mean for safe driving. Some programs combine educational content with training—whether by computer, simulator, or on the road—to help participants overcome some functional decline. Other programs target an individual's capabilities, to assist the older person in continuing to drive; the CarFit program, for example, helps people fit more comfortably into their personal vehicles.

Despite the range of programs, most have not undergone formal evaluations for improving driver skills, reducing traffic citations, or reducing crashes.

Photo: Dan Burden

By keeping fit and staying active, older drivers may be able to extend their driving lifetimes.

The few educational programs that have been evaluated, however, have increased the driver's knowledge and awareness (*9, 10*); increased self-reported safe driving behaviors (*11*); and improved on-the-road driving evaluation scores (*10*); however, they did not help to prevent roadway injuries and crashes (*12*).

Rehabilitation

Rehabilitation may slow or reverse some functional declines experienced by older adults. Fitness and cognitive rehabilitation programs, in particular, show promise. Fitness programs that improve range of motion, strength, and stamina may help older drivers extend their driving lifetimes. Proper and intensive cognitive training may improve cognitive functioning (*13*). Whether these programs can improve the cognitive abilities to have a positive effect on critical driving skills or to reduce older driver crash risk is not known.

Vehicle Design and Adaptation

Current vehicle designs do not take into account many of the functional declines associated with aging; this may not change for many years because of the beleaguered state of the industry. Nevertheless, little research specifically has addressed designs that optimize vehicles to account for age-related functional declines.

People who are experiencing functional declines, however, can make aftermarket changes to a vehicle to ease operation. Vehicle adaptations can help drivers with disabilities or aging-related concerns to get in and out of the car, fasten and unfasten safety belts, and operate the vehicle more easily. Because adaptive equipment must be customized to meet individual needs, the driver should work with an occupational therapist, who can recommend the correct equipment, and with a professional installer.

Although custom vehicle adaptations should improve traffic safety, no research has demonstrated the benefits. Research has indicated a lack of awareness of the options for vehicle adaptation not only among many older drivers who could benefit but also among the professionals who work with them.

Advanced Technology

Several technologies are now available or soon will be to help older drivers extend their safe driving careers. The most promising technologies include route guidance, night vision enhancement systems, collision warning systems, and automatic crash notification.

To be successful for older drivers, these technologies will need to be affordable, easy to use, and enhance safe driving. Poorly designed technologies could increase distractions for older users, leading to a higher risk of crashes. Systems designed for older drivers, however, would likely benefit drivers of all ages.

Research engineers at Nissan test the controls of a model; the driver wears a special restrictive suit and other gear designed to simulate the effects of physical aging.

Research shows that older drivers use advanced technologies differently from younger drivers and that older drivers take much longer to learn how to use the technologies (*14, 15*). Whether this is an effect of not growing up with computer technologies or of aging per se is not known. Nevertheless, the acceptance of advanced technologies by older drivers will depend on the quality of the training they receive.

Roadway Design

Another way to enhance the safety of older drivers is to design the roadway environment to accommodate common age-related functional declines—for example, by adding protected left-turn signals and improving roadway channeling, stop signs, and signal timing. Well-maintained roadway markings—such as painted edge lines and lane control marking—can enhance safety by providing visual cues to help drivers know which lane to use and to stay within the lane.

In addition, design improvements at intersections can benefit older pedestrians who are more likely than younger pedestrians to be killed by automobiles. Where appropriate, roundabout intersection designs show promise. The circular, nonsignalized design of roundabouts allows all traffic to move in the same direction around the center of the inter-

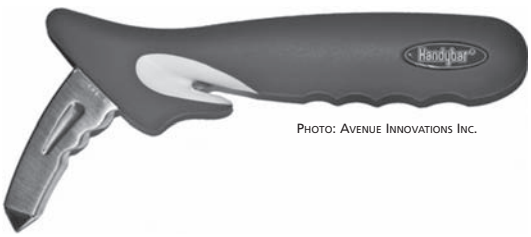

Photo: Avenue Innovations Inc.

Aftermarket vehicle adaptations such as the Handybar®, which fits into the striker plate of a vehicle's door frame and assists drivers in getting out of their cars, can make some aspects of driving easier for older adults.

Design improvements at intersections would increase the safety of older pedestrians, who are more likely than younger pedestrians to be killed by automobiles.

Photo: Dan Burden

section. The design may improve safety by alleviating some of the difficulties older drivers experience in negotiating intersections.

Discussion Threads

Several themes thread discussions of transportation and aging:

1. Mobility is a need for everyone. If mobility needs are not met by driving, then they must be met by other means.

2. Older adults vary in the functional declines they may be experiencing, in their ability to compensate for the declines, in their financial and social resources, and in their personalities. All of these characteristics interact with the factors that influence safe mobility.

3. All people—including older adults—need lifelong education to maintain safe mobility.

4. Research and programs that help older adults stay mobile will also help younger drivers.

5. Meeting the mobility needs of an aging population is complex and will require the expertise and collaboration of several academic and applied disciplines.

Acknowledgments

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The Safety and Mobility Patterns of Older Women in 2030

Defining and Meeting the Challenges

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Older women are the most likely travelers of any age to die in car or pedestrian crashes. The National Highway Traffic Safety Administration has concluded that unless something is done, these fatality rates will double or triple by 2030 (*1*). In addition, the driving restrictions that older women adopt are far more likely to have a negative impact on their mobility. Even when they are healthy and continue to be safe drivers, older women are substantially more likely than comparable men to stop driving completely.

More than three-fourths of all older people live in suburban and rural areas—the vast majority of older women therefore are living in places in which a car is a necessity. Older women also are substantially more likely to live alone, to be poor, and to lack retirement income other than Social Security.

Older women today must make a complicated choice—to continue to drive and face an increased risk of serious injury or death or to restrict or cease driving and face the even greater risk of social and emotional isolation. If these trends continue, what can be done so that no one has to face this intolerable dilemma? Examining the many differences in the travel behavior of older women and men can help in developing needed policies.

PHOTO: AAA FOUNDATION FOR TRAFFIC SAFETY

Research shows that when riding in a private vehicle, older women are much less likely to be driving than are older men.

Differences in Travel Behavior

At all ages, women today have patterns of licensing, trip-making, and modal choices that differ from those of comparable men. Some of the gender gap is closing among younger generations of travelers but is far from disappearing. Many of the differences seen between older people today may continue into the next two decades.

In 2006, almost 30 million Americans over 65 years of age had a driver's license. Older women, however, were far less likely to be licensed than comparable men; in the over-65 age group, 91 percent of all men but only 71 percent of all women had a license. Many women now over the age of 80 never learned to drive. But the licensing gap between younger cohorts of older people may reflect the greater likelihood that older women will stop driving at younger ages than comparable men.

Many studies have associated increased licensing with substantial increases in all aspects of travel for older and younger travelers alike. Between 1983 and 2001, licensing rates for older women increased by 50 percent, compared with only a 7 percent increase for men. Although men and women traveled substantially more in 2001, the increases were generally greater among women than among men.

Older women and older men drivers make the overwhelming portion of all their trips in a car, either as the driver or as the passenger. Neither group makes more than negligible use of public transit or of other modes of travel.

But riding in a private vehicle and driving the vehicle are two different activities. In 2001, when older women drivers traveled in a private vehicle, they were substantially less likely to be driving than were comparable men. The tendency to be the passenger, not the driver, was highest at the oldest ages. Almost two-thirds of male drivers over the age of

AARP offers an online Driver Safety program. Some research has found, however, that older women respond differently from comparable men to older driver training programs.

85—but only one-fourth of comparable women drivers—drove the vehicle in which they were riding.

Self-Regulation and Feelings About Driving

Older people are not risk-takers—they recognize that as they age, they may experience problems in driving, and they change their behavior in response. But older men and women exhibit substantial differences in almost every aspect of self-regulation.

Women and men find different kinds of situations to be problematic. Women are far more likely to find that driving situations have become difficult and to change their travel behavior; they are also far more likely to say that the change in their travel behavior has affected their mobility negatively. The most common form of self-regulation among older women is to cancel a trip when problems arise.

Women drivers are substantially more likely to find driving stressful and to express a lack of confidence in their driving abilities, even if they are objectively good drivers. This leads them to drive less often, which in turn reduces their confidence and increases their levels of stress—to which they respond by driving even less.

Paradoxically, driving less may have a negative impact on driving safety as well as mobility. Crash rates are related to the amount of driving. When crash data are controlled for level of exposure, most researchers find that the age effect in crash rates disappears. Crashes are overrepresented among people who do not drive very much, regardless of age.

This finding reinforces the dangers associated with women reducing their driving significantly. Although baby boomer women may drive more when younger, and therefore be more confident as drivers when older, the Federal Highway Administration has predicted that if 2001 patterns continue, the mileage gap between older women and men will widen over the next four decades (2).

Response to Safety and Educational Messages

NHTSA found that women younger than 65 responded differently to messages about driving safety than did comparable men; the study concluded that younger women needed different safety messages from those addressed to middle-aged women (3). Tuokko et al. concluded that educational materials for older drivers had to be targeted differently for women and men, because women were more willing to change their behavior, more consistent in their attitudes toward regulations, and used safer driving practices (4).

Some research has found that older women respond differently from comparable men to older driver training programs. A study of the AARP Driver Safety Program found that women participants were more likely to report that their driving skills had improved (5). Rosenbloom found that 1 year after participating in a variety of safety education programs in Tucson, Arizona, older women were more likely to respond that they did not engage in as much self-regulation as comparable men or as a control group of women who did not participate in the programs (6).

At a minimum, these findings suggest that the safety messages and educational techniques currently in use may have different impacts on women and men. But the findings also may suggest that older driver education programs may give competent women drivers a better idea of the strength of their current skills.

Driving Cessation

Most research shows that older women give up driving voluntarily at younger ages than comparable men and for less serious reasons. When older women cease to drive, they are much less likely than men to cite medical or health reasons. In a Tucson study, more than 90 percent of men, but only 46 percent of women, who stopped driving during the study reported the causes as serious medical or vision problems. Almost 18 percent of the women who stopped driving said that they "couldn't deal with the stress." None of the men gave that answer.

Married people are more likely to stop driving than those who live alone—but the effect is far more pronounced among women, who constitute the overwhelming number of unmarried older people. This suggests that older women who have a spouse who drives are more likely to cease driving.

The long-term implications of this decision can be tragic. In several studies, women who had ceased driving but subsequently lost their driving spouse to death or disability expressed regret that they had given up driving. Johnson found that older rural res-

idents who voluntarily stopped driving often had to resume because their social networks were not able to meet their mobility needs (*7*).

Driving cessation among older women is a response to a complicated set of factors, including a lack of confidence and the stresses of driving. Evidence is growing, however, that older women also are far more responsive to criticism of their driving skills—whether the criticism is valid or not—than are comparable men. Older women may lack confidence in their driving because their spouse directly or indirectly disparages their driving performance; several studies have reported many situations in which older women were discouraged from driving by their partners (*3, 8–10*).

Safety Statistics and Trends

Older drivers consistently have lower fatal crash rates per capita than those 21 to 64 years old. When the crash rates are based on exposure, however—that is, on the number of miles traveled—the crash risk increases for older drivers. Those 85 years old and older have the same crash rates per mile driven as those 20 to 24 years old (*11*). These travel indicators also reveal important differences between older women and men.

On a per capita basis per 100,000 of the population, older women were one-third as likely as older men to be involved in a fatal crash, according to updated 2005 data (*12*). In 2005, older men were a larger component of fatalities in the age group of 65 and older than in 1995. In contrast, between 1995 and 2005, the absolute number of crash fatalities among older women fell—often significantly—although the total population of women over age 65 increased by almost 12 percent.

Despite some positive trends in the data, older women and men constituted a larger share of crashes than they did of the U.S. population. In 2006, women over 65 accounted for 13.6 percent of all women but represented 20.8 percent of all female crash fatalities—the highest proportion of fatalities for any population group.

Ferguson and Braitman found that total crash involvement—whatever the outcome—and fatal crash involvement move in opposite directions (*13*). On a per capita basis, the fatal crash rate increases as people age; however, at all ages, the rate of total crash involvement was lower for women than for men. In 2003, almost 50 fatal crashes per 100,000 drivers involved men who were 85 years old or older, but only 20 involved comparable women.

Controlling for exposure, or miles driven, however, fatal crash involvement for drivers rises sharply after age 70 for men and women, with little difference. By age 85, both men and women drivers had the highest rate of fatal crash involvement among all drivers per 100 million miles traveled. Ferguson and Braitman found that total crash involvement per million miles traveled also rose after age 65, but far faster among men than among women (*13*). Although older women had fewer crashes per capita than older men, older women were far more likely to die in the crashes in which they were involved.

Women make up a majority of transit and special transportation users; suggestions for improvements to transit and special transportation or paratransit alternatives may address the needs of women.

Research and Policy Implications

Most experts agree that developing a range of policies and programs to improve the safety and the mobility consequences of an aging society is necessary, by addressing the following:

- **The driving and pedestrian environment**, including a focus on the driver, the vehicle, and the road network;
- **The public transit network**, including initiatives to improve the quality and to increase the quantity; to modify as appropriate the service provided—encompassing new or less traditional service and better travel information, personal security, safety, and accessibility; and to improve the vehicles and the training of drivers;
- **Alternative transportation systems**, including enhancements to the quality and the quantity of service, to the coordination between and among providers, and to dispatching programs, geographic information systems applications, driver training, vehicles, the effective use of volunteers, and expanded use of voucher systems; and
- **Neighborhood design**, including the development of intergenerational and elderly-friendly cities through community design, land use regulations, traffic enforcement, enhancement of personal security, and education, as well as alternative housing options for aging-in-place populations, new communities, and formal and informal active adult retirement communities.

PHOTO: ITNAMERICA

Many community-based programs provide rides for seniors but are not able to meet the full scope of needs, according to a study; Martha Giles (*left*), a volunteer with the Portland, Maine, affiliate of the nonprofit Independent Transportation Network, has logged more than 70,000 miles on local assignments.

The extent to which these types of improvements would meet either the differential or special safety or mobility needs of older women is unknown. The differences identified between women and men in so many aspects of travel and transportation, however, lead to questions about the applicability of one solution to meet the needs of women and men equally.

Improving the Driving Environment

Most research on improving the skills of older drivers and pedestrians does not distinguish between females and males. Almost everything that improves safety and mobility for all older travelers will work for older women. Nonetheless, older women may have safety and mobility needs that are increased or different compared with those of older men. Research and policy analysis therefore need to focus on these differences, as well as on measures that have a positive effect on women and men as they age.

Strategies to improve the driving environment or the vehicle often draw no distinction between the sexes. Older people have trouble with lane markings, signs, and directional messages; whether women and men exhibit important differences in these tasks is not known; if differences are found, programs need to respond and adapt accordingly.

Similarly, information is lacking on how women and men respond to different kinds of safety belts, crash avoidance systems, and other in-car equipment. Older women experience more stress when driving and are more vulnerable in crashes, but studies have yet to determine specific vehicle components that may improve crash protection for women—who tend to be of smaller stature and have different body characteristics—or that may contribute to a less stressful driving experience.

Although some research shows that women and men differ in how they receive and process educational messages about safety and safe driving behavior, more research is needed to investigate ways to target safety programs to older women. Research-based guidance is needed on the most effective ways to prepare training and education programs, media messages, and incentives to encourage women to keep driving safely as long as possible.

Public Transit and Special Alternatives

A large body of research has outlined the improvements needed in traditional public transit systems and special services for older adults. Since almost 9 out of 10 transit and special transport users over age 65 are women, many of the research or policy suggestions for improving transit and special transportation or paratransit alternatives may address women's specific public transit needs, which range from improved personal security at stops and on board to the restructuring of routes to serve preferred origins and destinations. The extent to which women and men may differ in their responses to specific improvements or services, however, is not known.

Many older women and men live far from public transit services, and if available, the services often are designed for commuters. Substantially increasing the quantity and the quality of public transit services and of alternative services is important. Many federal programs fund special services, and every community hosts different kinds of providers—some programs facilitate volunteers providing rides, and some large systems offer special vehicles and paid drivers.

A study for the Institute of Medicine, however, found that even taken together these providers were unlikely to offer an average of more than three trips a year to each older person with disabilities in their community (*14*). Moreover, many of these providers tended to limit severely the kinds of trips they serve—for example, allowing only medical trips or agency trips—so that eligible older people must find other means for social, recreational, or grocery trips.

Neighborhood Design

Many different kinds of land use and planning changes could create communities that facilitate walking or using public transit instead of relying on the car, thus enhancing older people's health, as well as their mobility. Some research, however, suggests that these land use changes also may make communities busier and more active in ways that can be detrimental to older people, and particularly to older women; moreover, that women and men perceive many design components of the environment differently and therefore modify their travel patterns dif-

ferently in response. For example, women tend to perceive situations as more dangerous than do comparable men and do not react in the same way to design changes—such as lighting improvements—that are intended to increase personal security. Good information is lacking on the extent to which any of the land use, community design, and housing options suggested to create more livable communities actually improve the mobility and safety of older women.

A Threefold Strategy

Society's challenge is to identify and develop a repertoire of mobility and safety options that allow older people, particularly women, to maintain their independence and access in safety. Meeting the dual challenges of keeping older women both safe and mobile requires a threefold strategy in the coming decades:

1. Alter the automobile-based system to facilitate the task of driving, with a focus on resolving the specific problems of older women;
2. Develop a range of appropriate transportation alternatives to meet the special mobility needs of older women, and
3. Redevelop, redesign, and retrofit the communities in which older people are aging.

This threefold strategy requires additional research and policy development, as well as substantial funding. Not enough is known about differences in the way older women and men react to various elements of the highway system or about the vehicle characteristics that will keep women safer and make driving less stressful. Not enough is known about how older women react to different educational and driver training programs, so that the programs can be redesigned to be more effective.

Research has shown how to make public transit and alternative transportation options more useful for older women—the most important changes are to increase the level and quality of services by many orders of magnitude. Although creating the kinds of communities in which older women and men can rely far less on the private car is an exciting idea, the challenge is to focus on the automobile-dependent neighborhoods in which the vast majority of older people are aging.

PHOTO: DAN BURDEN

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SPECIAL FEATURE

Communicating Transportation, Energy, and Climate Change Concepts to the Public

TRB Contest Identifies Exemplary Efforts

JUDY A. MEYER AND JENNIFER L. WEEKS

Meyer owns and operates Public Information Associates, Allen, Texas. Weeks is a Professional Associate and Senior Supervising Planner, Parsons Brinckerhoff, Baltimore, Maryland, and chairs the TRB Public Involvement in Transportation Committee.

Transportation professionals often find that communicating critical transportation concepts to a nontechnical audience is a challenge. Some have assembled tools, graphics, or the right words to convey their message, but opinion research indicates that transportation professionals face a largely uninformed public.

Communicating and building relationships with the people who rely on a variety of transportation modes to live, work, and play is a relatively new task. The Roman builders of the famous roads and aqueducts may not have spent a lot of time communicating with senators, nobility, or common citizens to determine a project's need, location, or design. When the Wright brothers took their first flight, the concepts of a Part 150 noise study or of airspace minimums did not yet exist.

Today, expectations are different. The transportation system is a complex network of roads, bridges, railroads, airports, services, ports, and more, affecting everything from the economy to the environment.

Federal transportation law and regulations require state departments of transportation (DOTs), metropolitan planning organizations, and transit agencies to consult with and involve a variety of stakeholders in decision making. Federal decision making about transportation is littered with laws and regulations that affect technical decisions about the delivery of transportation improvements and services. Successfully engaging stakeholders requires the effective communication of a myriad of issues and relationships throughout the entire decision-making process—from the initiation of a long-range system plan to project construction to system operations and maintenance.

Not only have the rules become more complex, but the public's levels of education, sophistication, and engagement with the world have increased. The public expects the effective communication of the concepts, principles, and purposes of transportation—communication is critical for the community's understanding and acceptance of transportation decisions.

The contest-winning entry, Transportation-Town.com, features an interactive game that facilitates collaborative development of a vision for transportation, land use, and growth in Whatcom County, Washington.

Seeking Successful Methods

In 2007, the Planning and Environment Group of the Transportation Research Board (TRB) launched a competition to stimulate fresh and creative methods of communicating technical transportation issues and concepts to John and Jane Q. Public and to share the methods that have proved successful. The target audiences for the communications range from elementary school children to adults living in retirement communities, as well as elected officials, business owners, and commuters. To ensure that entries meet the ambitious objective of communicating with all possible audiences, the competition judges are drawn from a range of professional backgrounds, including school teachers, journalists, administrative assistants, and transportation professionals.

The contest has proved a great success. More than 70 entries were submitted to TRB in a range of communication media. TRB Executive Director Robert E. Skinner, Jr., presented awards to 11 entries in a special poster session at the 2008 TRB Annual Meeting in Washington, D.C. With the overwhelming response from contest participants and the interest

Melissa Miller, Whatcom Council of Governments, Bellingham, Washington, with the poster display of TransportationTown.com, which included a computer demonstration.

shown by attendees, TRB has made the contest an annual event, addressing a different transportation issue or theme each year to provide variety for the contest and to appeal to different groups within the transportation industry.

This past year's competition focused on energy and climate change in transportation, the spotlight themes of the TRB 2009 Annual Meeting. The selection of a hot topic within the transportation industry yielded a small, but focused, set of entries, ranging from a book to multimedia presentations and interactive online games.

The quality of the entries demonstrates the talent within the industry for communicating complex technical concepts to the layperson. The entries epitomized the goal of communicating complex information in an uncomplicated manner. TRB designated one winner and four finalists.

Contest Winner

TransportationTown.com: A Regional Transportation Website, the winning entry, aims to engage and educate visitors about transportation in Whatcom County, Washington. The site targets citizens seeking information about various modes of transportation, with links provided for each mode. The home page presents regionally relevant information about land use, transportation, and multimodal planning.

An interactive game invites visitors to build a city by placing icons on a map. Within a set amount of time—representing 1 year—players make decisions about relationships between land use and transportation; the results are then displayed. The game visually demonstrates how the player's decisions affect air quality, mobility, and city appeal; the relative values of investment in transportation modes also are shown.

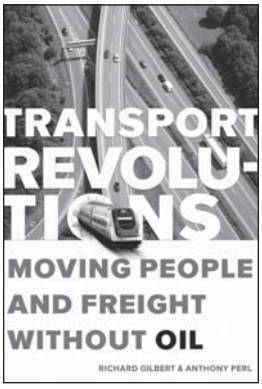
The goal of the game is to build a prosperous city through land use and transportation decisions that keep mobility high, pollution low, and the citizens happy. Dials track pollution, mobility, and the happiness of the citizens and allow players to monitor their progress and see the effects of their decisions. The entry was developed by the Whatcom County Community Advisory Group, represented at the Annual Meeting poster session by Melissa Miller, Whatcom Council of Governments, Bellingham, Washington. The website is located at www.transportationtown.com.

Finalists

Transport Revolutions: Moving People and Freight Without Oil

Transport Revolutions: Moving People and Freight Without Oil, a 2008 book by Richard Gilbert and Anthony Perl, traces out several revolutions—defined as major changes in how people and freight move—in the coming decades in transportation. These changes will be the result of declines in world oil production and rises in the prices of oil products.

The authors, who are with the Urban Studies Program at Simon Fraser University, Vancouver, British Columbia, Canada, examine past revolutions and describe transportation and its impacts today. They note that the United States and China can accommodate oil depletion without reducing mobility. For example, by 2025 electric traction of various kinds could propel more than 30 percent of surface transportation in the United States. The book also describes the coming revolutions in aviation and marine transportation.



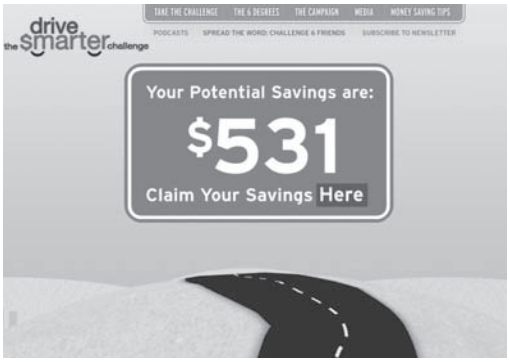
Cover of the paperback edition; the book explores the worldwide transition from oil-based fuels.

Drive $marter Challenge

The Drive $marter Challenge, an interactive website of the Alliance to Save Energy, Washington, D.C., served as a call to action as part of a multimedia campaign to promote fuel efficiency. The website, assembled by Ronnie Kweller and Rozanne Weissman at www.drivesmarterchallenge.org, shows how human actions have a ripple effect on fuel consumption and emissions.

Drivers can find out immediately how much money they can save—often hundreds of dollars—through six driving and maintenance actions on their own vehicles, by specific make, model, and year. Drivers then can decide whether to take the challenge and commit to any one of six actions, and they can challenge others to make the commitment as well.

Individual savings—dollars, gallons, and carbon dioxide emissions—are added to the running total, recorded on

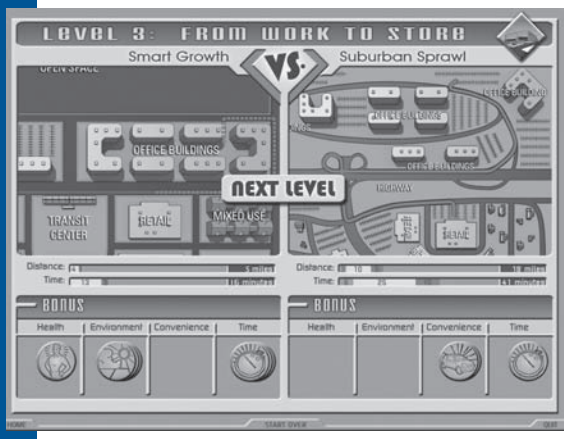


The Drive $marter Challenge website allows participants to enter information about their car make, model, and year, obtain an annual savings total by applying six maintenance actions, and receive energy-saving tips on driving and automobile maintenance.

the home page, of all who have taken the challenge. The website also offers money-saving gas tips in English and Spanish, related resources, and myth busters—objective information that contradicts popular misconceptions.

Your Community—
Smart Growth Versus Suburban Sprawl

New Jersey DOT and Parsons Brinckerhoff developed the interactive CD-ROM demonstration, Your Community—Smart Growth Versus Suburban Sprawl, to support the agency's educational efforts to integrate transportation and land use. Part of New Jersey DOT's Long-Range Plan 2030 outreach program, the demonstration consists of a series of trips through two hypothetical communities. One community reflects smart growth approaches, with integrated land use and a multimodal transportation system; the other reflects suburban sprawl, with isolated land uses that require travel by private automobile.



A screen from the CD-ROM developed by New Jersey DOT and Parsons Brinckerhoff depicts options and outcomes for work-to-store travel under smart growth and sprawl; the demonstration illustrates the complex relationships between land use and transportation.

Trips to school, work, and other destinations are shown graphically, with a summary of miles traveled by automobile, transit, or walking, plus a comparison of time spent for each commute. Points are awarded for efficiency and qualitative health and environmental benefits. The interactive program demonstrates the potential environmental, health, convenience, and time advantages of smart growth, educating people to make choices that reduce their carbon footprint.

The project team included James B. Lewis and Danielle Graves, New Jersey DOT; Jerome Lutin, formerly of New Jersey Transit; and Pamela M. Lebeaux and Marc Steuben, Parsons Brinckerhoff.

BWC and Climate Change:
Making the Connection

The Best Workplaces for Commuters (BWC) designation is the national emblem representing outstanding commuter benefits. Millions of commuters who work at BWC-designated worksites leave their cars at home, easing congestion and air pollution and reducing greenhouse gas (GHG) emissions.

The interactive program, BWC and Climate Change: Making the Connection, assembled by Ian Todreas of ERG, Boston, Massachusetts, aims to help employers make and broadcast the connection between transportation demand management (TDM) and climate change. Users leverage new opportunities to position BWC—and more generally, commuter benefits—as a near-term, cost-effective solution to climate change.

The Best Workplaces for Commuters (BWC) campaign shows employers how commuter benefits can play a significant role in mitigating some of the causes of climate change. Ian Todreas, ERG, Boston, Massachusetts, provided a review of the BWC website and its features at the TRB 2009 Annual Meeting.

The website features national and state-specific information about climate change; state-specific information on climate and TDM policies, players, and funding sources; local, state, regional, and national climate and transportation organizations; and funding sources that might be available to support TDM as a climate change solution. The website contains messages and talking points on how to promote local and regional BWC programs as a climate-friendly TDM solutions and how the climate benefits of BWC compare with those from other transportation strategies. The website also has links to tools to measure the impact of climate change strategies.

What's on Tap for 2010

The contest to be featured at the TRB 89th Annual Meeting, January 10–14, 2010, focuses on communicating about issues related to providing and operating public transportation. The purpose is to tackle the challenges of communicating the role of transit in the larger transportation system, as well as unique technical issues such as transit operations and maintenance, costs and financing, and transit project delivery, including the Federal Transit Administration's complex New Starts process. The entries should help agencies remove the mystery from public transit for everyone from elected officials to the traveling public.

Service Life Modeling

Selecting Repair and Rehabilitation Options for Bridge Structures

ALI AKBAR SOHANGHPURWALA AND IVAN R. LASA

Sohanghpurwala is President, CONCORR, Inc., Sterling, Virginia; and Lasa is Corrosion Mitigation and Rehabilitation Technologist, Corrosion Research Laboratory, Florida Department of Transportation, Gainesville.

Evaluating the corrosion condition of a reinforced concrete structure is essential in developing a strategy for repair and rehabilitation after corrosion-induced damage. Several destructive and nondestructive test methods and techniques are available to ascertain the corrosion condition of the reinforcement in portions that do not yet show concrete damage. Most of these techniques, however, require significant resources to implement and then additional resources to interpret the data and make the decisions about repair and rehabilitation.

The National Cooperative Highway Research Program (NCHRP) therefore initiated a project to develop a protocol for evaluating the condition of bridge superstructure elements, for estimating the remaining service life, and for identifying the options for mitigating the corrosion. The project findings, published in 2006 in NCHRP Report 558, *Manual on Service Life of Corrosion-Damaged Reinforced Concrete Bridge Superstructure Elements*, produced a condition survey protocol, a model for remaining service life, and a susceptibility index to designate the likelihood of corrosion.

View of one of the examined bridges on I-95 near Bangor, Maine, showing cracking caused by reinforcement corrosion. Condition evaluation included a delamination survey, cover depth measurements, chloride ion content analysis, and petrographic analysis.

Problem

The National Bridge Inventory database, maintained by the Federal Highway Administration, contained a total of 587,964 bridges as of 2002. The average age of the bridge structures in the database is 40 years; 41 percent of the bridges are at least 40 years old.

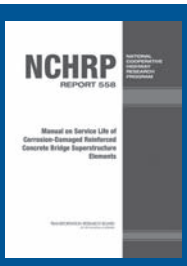
The condition of the nation's aging highway bridge infrastructure has gained significant attention in the past two decades. Several independent evaluations of the condition of the nation's infrastructure have used the ratings in the database. These studies ascertained that 14 percent of the bridges were rated structurally deficient and that the primary cause of the deficiency was corrosion of the reinforcing steel. For the 20-year period from 1999 to 2019, the estimated cost of maintaining the nation's bridges is $5.8 billion per year, and the estimated cost of improving the same bridges and eliminating their deficiencies is $10.6 billion.

To address deterioration from corrosion, a bridge owner must decide whether to maintain, repair, or replace the structure, considering its present condition and its expected condition. The owner also must identify the materials and methods that are most appropriate to the task. Because of the lack of standard decision-making processes, most owners have made these complex decisions by relying on local experience and expertise. These decision-making processes often have resulted in inefficient, costly, nonstandard, and nonoptimal solutions.

A protocol capable of determining the optimal course of action—maintenance, repair, or replacement—and of assisting in the selection of the best materials and methodology was urgently needed.

Solution

Determining the optimal course of action requires information about the present condition of the structure and its expected deterioration. The present condition determines the quantity and the type of repairs necessary. The owner can use the expected future deterioration to determine the efficacy of alternative repairs and to assist in selecting a repair-and-



Manual Describes Protocols

NCHRP Report 558, *Manual on Service Life of Corrosion-Damaged Reinforced Concrete Bridge Superstructure Elements,* presents the findings of a research project conducted by CONCORR, Inc. The manual offers step-by-step procedures to assess the condition of corrosion-damaged bridge elements. Also included are procedures for estimating the expected remaining service life of reinforced concrete bridge superstructure elements and to determine the effects of maintenance and repair options on a structure's service life. The report is available online at http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_558.pdf.

prevention strategy to minimize the cost of maintenance for the period of service life desired from the structure.

The future corrosion activity can be projected either from the estimated remaining service life of the structure or as a function of the concrete deterioration caused by the corrosion of the reinforcement. The remaining service life method requires the owner to formulate a criterion to define the end of the service life. The other approach, applying a function of concrete deterioration over time, provides the owner with scientific data on the progression of damage and facilitates identifying the types and timing of the most appropriate actions. The NCHRP project chose the second approach, which is more flexible. For simplicity and to conform to the naming convention in the literature, the project termed the process "service life modeling."

Although several mathematical methods have been proposed to model the corrosion process according to the extent of deterioration and the presence or absence of deleterious agents, none has been found to be comprehensive, verified scientifically, or standardized for the bridge community. The model developed in the NCHRP project, however, was statistically validated on three bridge structures in Kentucky, Ohio, and Maryland.

The model requires results from a delamination survey, a few cores for chloride profile analysis, and clear concrete cover data. A susceptibility index, based on the distribution of chloride ions in sound concrete, narrows the options available for corrosion control.

Applications

Florida has applied the model on several bridge structures. On the I-75 bridges over the Caloosahatchee River and the Tidal Marsh in Fort Meyers, Florida, a consultant used the results of service life modeling to recommend widening of the bridges with repairs instead of a complete replacement, producing a considerable savings for the state. The service life modeling provided confidence in the option of widening and repairs by providing a clear view of expected future damage.

The model also was used on the Courtney Campbell Bridge in Tampa to ascertain the magnitude of the corrosion problem and the options available for repair and rehabilitation. The model was applied recently for the historic North Torrey Pines Road Bridge, in Del Mar, California, to determine the best options for repair and rehabilitation of the substructure elements while maintaining the historical characteristics.

Other applications include the substructure elements of four bridges on I-95 near Bangor, Maine; piers of the Military Ocean Terminal, Sunny Point, North Carolina; piers of the Port of Moorehead City, North Carolina; and the terminal used by Alcoa in Charleston, South Carolina. In each instance, use of the model has resulted in the optimal design of repairs and of corrosion control systems.

Benefits

The model and the susceptibility index provide a streamlined mechanism for performing the corrosion condition survey and applying the survey results to determine the future progression of damage and to select the optimal repair and corrosion control system. The service life model allows the owner to perform life-cycle cost analyses of various options according to estimates of the progression of damage.

Service life modeling offers another advantage, by reducing the amount of field data collection and sampling. The model requires only the results of the delamination survey, chloride profile analyses, and a concrete clear cover survey.

The condition evaluation protocol of this model can be integrated easily into the routine bridge inspection. In addition, the model can be used to ascertain future susceptibility to corrosion-induced damage and the magnitude of the damage, so that the optimal corrosion control systems can be installed to reduce or stop corrosion and increase the remaining service life.

For more information, contact Ivan R. Lasa, Corrosion Research Laboratory, Florida Department of Transportation, 50057 NE 39th Avenue, Gainesville, FL 32609; 352-955-2902; ivan.lasa@dot.state.fl.us; or Ali Akbar Sohanghpurwala, CONCORR, Inc., 45710 Oakbrook Court, Sterling, VA 20166; 571-434-1852; ali@concorr.com.

EDITOR'S NOTE: Appreciation is expressed to Amir Hanna, 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, Keck 488, 500 Fifth Street, NW, Washington, DC 20001 (telephone 202-334-2952, e-mail gjayaprakash@nas.edu).

CALENDAR

TRB Meetings

November

12–13 Developing a Research Agenda for Transportation Infrastructure Preservation and Renewal
Washington, D.C.

16–18 5th National Transit GIS Conference*
St. Petersburg, Florida
Thomas Palmerlee

December

13–15 Transportation Policy and Finance Summit*
Washington, D.C.

13–18 12th International Conference on Travel Behavior Research*
Jaipur, India
Kimberly Fisher

2010

January

10–14 TRB 89th Annual Meeting
Washington, D.C.
www.TRB.org/AnnualMeeting

March

TBD Road Safety on Four Continents Conference*
Abu Dhabi, United Arab Emirates

April

12–16 1st International Conference on Pavement Preservation*
Newport Beach, California

27–29 High-Speed and Intercity Passenger Rail Systems and Strategies Joint Rail Conference*
Urbana, Illinois
Elaine King

May

5–7 1st International Conference on Nanotechnology in Cement and Concrete
Irvine, California

9–12 Innovations in Travel Demand Forecasting: 2010
Tempe, Arizona

13–14 Innovations in Pricing of Transportation Systems: Workshop and Conference*
Orlando, Florida

19–21 Transportation Finance: Forging a Sustainable Future—Now
New Orleans, Louisiana

30–June 2 Safety and Mobility of Vulnerable Road Users: Pedestrians, Motorcyclists, and Bicyclists*
Jerusalem, Israel
Richard Pain

June

2–4 TRANSED 2010: 12th International Conference on Mobility and Transport for Elderly and Disabled People*
Hong Kong, China

2–5 4th International Symposium on Highway Geometric Design*
Valencia, Spain

3–5 GeoShanghai 2010 International Conference*
Shanghai, China

6–10 Environment and Energy in Transportation Summit*
Raleigh, North Carolina

21–24 North American Travel Monitoring Exposition and Conference (NATMEC): Improving Traffic Data Collection, Analysis, and Use
Seattle, Washington
Thomas Palmerlee

July

11–14 49th Annual Workshop on Transportation Law
Newport, Rhode Island

11–14 TRB Joint Summer Meeting
Minneapolis, Minnesota

11–15 5th International Conference on Bridge Maintenance, Safety, and Management*
Philadelphia, Pennsylvania

September

TBD International Conference on Sustainable Concrete Pavement Technologies: Practice, Challenges, and Directions*
California

October

10–13 9th National Conference on Access Management*
Natchez, Mississippi

25–27 6th International Conference on Visualization in Transportation
TBD
Richard Pain

26 Using National Household Travel Survey Data for Transportation Policy Decisions
Washington, D.C.

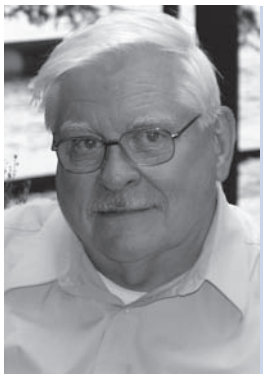
Additional information on TRB meetings, including calls for abstracts, meeting registration, and hotel reservations, is available at www.TRB.org/calendar. To reach the TRB staff contacts, telephone 202-334-2934, fax 202-334-2003, or e-mail lkarson@nas.edu. Meetings listed without a TRB staff contact have direct links from the TRB calendar web page.

*TRB is cosponsor of the meeting.

John D. Wilkins

Consultant

During his studies at Carnegie Institute of Technology—now Carnegie Mellon University—in Pittsburgh, Pennsylvania, John D. Wilkins was mentored by the management staff of Pittsburgh Railways. The Western New York native notes that this played a vital role in his career: "Formal education takes one a fair distance down a career path. Of equal importance are the associations that one is privileged to have enjoyed." Through the guidance of managers such as Charles Schauck of Power and Inclines, Wilkins gained valuable insight and experience into transit property management and operations, as well as knowledge about overhead electrical system design, embedded track design, and fleet maintenance requirements.



"There is no nirvana; today's solutions are not necessarily tomorrow's solutions. Research is a continuing activity."

With a bachelor's degree in civil engineering and transportation and a master's degree in business administration from the University of Pittsburgh, Wilkins began his career as an engineer at New York State Natural Gas in 1962; there, he facilitated the construction of high-pressure natural gas transmission lines. Wilkins transferred to transportation planning as senior associate at Coverdale & Colpitts in New York in 1971, and in 1975 moved on to Chase, Rosen, & Wallace, Inc., as vice president of transportation planning. He led projects that included a revamping of local bus services for Newark and Elizabeth, New Jersey, and a planning and conceptual engineering study for light rail transit (LRT) service between Jersey City and Bayonne—a precursor to the New Jersey (NJ) Transit Hudson–Bergen LRT line.

In 1981, Wilkins embarked on a career at NJ Transit that lasted more than 25 years. As director of operations planning, he established an organization to conduct continuous transit services monitoring, headed the transit network rationalization effort, and installed the agency's first computerized scheduling system. At NJ Transit, he continued his contributions to the Hudson–Bergen LRT line as director of project planning, working with the Governor's Waterfront Planning Office to undertake an environmental impact study (EIS), as well as planning and conceptual engineering efforts. As director of planning research, Wilkins conducted a study to identify possible intelligent transportation system applications on bus and rail systems, which resulted in the installation of test programs for an automatic passenger counting system for buses and real-time passenger information at rail stations.

Many urban rail systems needed the support of technical and research organizations to advance the technology harnessed by vehicles, operations, overhead contract systems, track structure and maintenance, and other systems, recalls Wilkins: "With the decline of urban rail systems, many of these organizations disbanded or shifted their emphasis to motor coach technology. With the reintroduction of urban rail—now called light rail—a new era of research was required to meet the needs of planners, designers, and operators." Professional and research organizations have come to fulfill this need, he adds.

As NJ Transit's director of capital planning and programming, Wilkins participated in the EIS and conceptual engineering efforts of the Trans-Hudson Express (THE) Tunnel project, an $8 billion undertaking of NJ Transit and the Port Authority of New York and New Jersey that will increase travel capacity to Manhattan's Pennsylvania Station. Also called Access to the Region's Core, the THE Tunnel project is under way and is scheduled for completion in 2017. Wilkins also conducted the EIS and conceptual engineering efforts for the $2 million Portal Bridge replacement project on the Northeast Corridor near Newark.

"There is no nirvana; today's solutions are not necessarily tomorrow's solutions," Wilkins observes. "Research is a continuing activity."

Active in TRB since 1975, Wilkins has attended or participated in all the Light Rail Transit Conferences since then. He has served on the Rail Transit Systems Committee since 1992 and since 1994 has served on the Light Rail Committee, which he has chaired for the past 5 years. He is also a member of the TRB Technical Activities Council Public Transportation Group and the Public Transportation and Development Committee.

"The best advice I could give new entrants into the field is to emulate a sponge; absorb all you can," advises Wilkins, who also serves the American Public Transportation Association as a member of the Light Rail Forum. He was secretary of the Metropolitan Association of Railway Officials, and as a member of the New Jersey Railroad and Transportation Museum Commission from 1988 to 2004, Wilkins developed a concept, plan, and site recommendation for a state railroad and transportation museum. A keen interest in railroad history has led Wilkins to help create the Friends of the New Jersey Transportation Heritage Center, which he serves as president.

Wilkins' publications include "Use of Railroad Rights-of-Way for Light Rail Transit Systems," coauthored with Arthur Schwartz in 1978, and "Considerations for Effective Light Rail Street Operation," coauthored with Joe Boscia in 1985.

Johanna Zmud

NuStats, LLC

All transportation researchers will be involved, at some point, in data collection. As president of NuStats, LLC—a survey science consultancy based in Austin, Texas—Johanna Zmud spends much of her time improving data collection methods to meet transportation objectives. "The traditional responses to the challenges of transportation safety, congestion mitigation, and environmental protection involve infrastructure or equipment. Improving our understanding of people's travel behavior—the how, why, when, and where they choose to travel—is at least as important for sound policy and planning," Zmud observes.

Zmud cofounded NuStats 25 years ago to bring rigorous and cutting-edge survey research techniques to the study of transportation, health, education, the environment, and public safety. In the late 1980s, she perceived a need for a solution to travel behavior measurement challenges within the survey science tradition, and guided NuStats to fill that gap. Zmud sought to improve the quality of the data available for decision making, with a focus on linking transportation planning and sound survey science. NuStats is now the largest producer of primary travel behavior data in the United States.

"Our data assets must align to current conditions and, more importantly, anticipate emerging challenges."

In a 2007 TRB transportation data needs assessment with Joseph Schofer, Tim Lomax, and Tom Palmerlee, Zmud coined the phrase "data as an asset." Because of increasing requests from policy makers and new legislative reporting requirements, the demand for data exceeds the supply. The value of the data asset must be recognized, invested in, and prudently managed, Zmud observes: "Our data assets must align to current conditions and—more importantly—anticipate emerging challenges such as climate change or new technology, changing demographics, land use, or different options for financing transportation." Zmud notes, however, that the transportation data infrastructure is "the most neglected asset in our transportation balance sheet, despite its potential for improving people's lives."

Although Zmud's training is in the social sciences, almost all of her professional career has been in the transportation research arena. Zmud received a bachelor's degree in foreign languages from East Carolina University, with master's degrees specializing in educational statistics from the University of Maryland and in communication management and policy from the University of Southern California (USC). She received a PhD in communication research from USC's Annenberg School.

Zmud's theoretical and technical social science background complements a growing expertise in transportation policy and planning issues. In addition to her responsibilities as president of NuStats, Zmud continues to direct large-scale travel surveys as a way to monitor and refine her firm's performance and leadership in the field. As Zmud explains, "NuStats operates with the vision of continual improvement—reinventing research techniques and approaches dynamically as circumstances change." She has been instrumental in leading the practice in applying new technologies to capture an expanding set of data requirements more quickly and cheaply. New data capture technologies are necessary investments; then, as systems are institutionalized and standard operating procedures are refined, new technologies often result in cost efficiencies, notes Zmud.

Zmud has a history as a serial entrepreneur. In 2000, Zmud and Jean Wolf founded GeoStats, a firm focused on technology applications in transportation research. Almost 10 years later, NuStats is a partner to Mygistics, a firm creating a detailed, contiguous model of the entire United States, Canada, and Mexico, simulating all travelers on the network to accurately predict current and future traffic volumes and travel times. NuStats brings a survey research component that will use Mygistics technology to create the first nationwide transportation panel.

Zmud credits her long history of active engagement in TRB activities for her continued focus on emerging needs for, and sources of, passenger and freight data. Currently, she chairs the Data and Information Systems section of the Technical Activities Council's Policy and Organization Group, presiding over 11 committees that work to raise awareness about weaknesses or gaps in transportation data and to highlight effective techniques for strengthening the nation's transportation data infrastructure. Before this, Zmud chaired the TRB Travel Survey Methods Committee. Outside of the data section, she is an active friend of the travel behavior, road pricing, and public transit committees, and a member of the TRB–National Research Council Committee on Equity Implications of Alternative Transportation Finance Mechanisms, the National Cooperative Freight Research Program Project Panel for the Truck Idling Scoping Study, and planning committees for the Innovations in Travel Modeling Conference and the Freight Data Research Road Map.

Zmud's other activities include cochair of the International Steering Committee on Travel Survey Conferences, and member of the Regional Infrastructure and Development Committee of the Greater Austin Chamber of Commerce.

SHRP 2 RESEARCH UPDATE—Jim Sayer, University of Michigan Transportation Research Institute (*at podium*), relates recent news about data manipulation and integrity as part of the Fourth Safety Research Symposium sponsored by the Second Strategic Highway Research Program (SHRP 2) at the Keck Center of the National Academies in Washington, D.C., on Thursday, July 23. Sayer joined Trent Victor of Volvo, Sweden (*seated, facing audience*); Wu Hongbo of China; Fred Wegman of the SWOV Institute for Road Safety Research, Netherlands; and Tom Dingus of Virginia Tech Transportation Institute, at the session to present updates on SHRP 2 international research.

CREATIVE TRANSIT TECHNOLOGY—Gordon Drukier of Advanced Fuel Research, Inc. (*left*), describes the second phase of a project using security cameras to detect radioactivity in transit stations to Transit Innovations Deserving Exploratory Analysis (IDEA) program panel members (*from left:*) Greg Hull, Michael Taborn, John Walsh, Gregory Cook, Mike Flanigon, and Henry Nejako, on Thursday, August 6, at the Keck Center. The prototype system explored in Drukier's project would integrate the transit security cameras already installed in subway stations with newly developed software that could detect radioactive materials nearby.

IN MEMORIAM

Wayne Shackelford 1933–2009

GEORGIA DOT

Wayne Shackelford, 75, former Commissioner of the Georgia Department of Transportation (DOT) and past TRB Executive Committee Chair, died Tuesday, September 1, in Snellville, Georgia. As Georgia DOT Commissioner from 1991 to 2000, Shackelford presided over an era of swift growth and transportation development in the state, and supervised such projects as the transportation management program for the 1996 Olympic Games in Atlanta. In 1996, he became a member of the TRB Executive Committee, serving as chair in 1999 and as a member until 2002.

Born in Carroll County, Georgia, in 1933, Shackelford graduated from Berry College in Rome, Georgia, and took graduate courses at the University of Georgia in Athens. He worked as a Haralson County extension agent, and in 1960 began a long career in the Gwinnett County administration. After several decades with Gwinnett County, Shackelford became a real estate developer; his projects included the Town Center Mall in Kennesaw, Georgia, and Gwinnett Place Mall. His vision of growth and establishment of infrastructure set the precedent for the rapid expansion of the Atlanta suburbs in the 1980s and 1990s.

In 1991, Governor Zell Miller nominated Shackelford—known to friends as "Shack"— as Commissioner of the state DOT. During Shackelford's 9-year tenure, the state's population grew by 1.5 million and the budget for the 3-year list of approved transportation projects expanded from $2.6 billion to $5.1 billion. He also was involved in the creation of the Transportation Management Center in Atlanta, and played a vital role in implementing intelligent transportation systems (ITS) in preparation for the 1996 Olympics.

After returning to the private sector in 2000, Shackelford continued his work as a community advocate, lobbying for a commuter rail line linking the Atlanta campuses of Emory University and Georgia Tech—nicknamed the "Brain Train." In 2007, the new interchange between SH-316 and I-85 was named in Shackelford's honor.

From 1995 to 1999, Shackelford served on the TRB Strategic Highway Research Program (SHRP) Committee, which advised the Federal Highway Administration and the American Association of State Highway and Transportation Officials (AASHTO) on the conduct of a national program to implement the results of the first SHRP. In addition to his service as member and chair of the TRB Executive Committee, he was also a member of its Subcommittee for National Research Council Oversight and its Subcommittee on Planning and Policy Review.

Shackelford served as President of AASHTO in 1995 and as president of the Southeastern Association of State Highway and Transportation Officials in 1993. He also chaired the Board of Directors of the Intelligent Transportation Society of America from 1998 to 1999. In 2001, for his outstanding contributions to highway progress, Shackelford received the George S. Bartlett Award, awarded jointly by AASHTO, the American Road and Transportation Builders' Association, and TRB. Shackelford was a board member of the Georgia 4-H Foundation and of the Gwinnett County Fair Association, and a lifetime member of the Gwinnett Historical Society.

Drivers perceive an increase in distracted driving, aggressive driving, and speeding on the roadways.

Fewer Highway Crashes, But More Danger Felt

The number of fatalities from car crashes last year was the fewest since 1961, the AAA Foundation for Traffic Safety reports, but many drivers say they feel less safe on the roads today than they did 5 years ago. According to the 2009 Traffic Safety Culture Index, released in July, drivers stated that distracted driving was a serious threat to their safety, but admitted that they too engaged in many of the same behaviors while driving—sending text messages or e-mails, talking on cell phones, and running red lights.

About half of the drivers surveyed said that driving safety was about the same as it was 5 years ago; however, only 12 percent reported that they felt safer driving now, and 35 percent thought they were less safe. About one-third of the drivers who reported feeling less safe cited distracted driving, along with aggressive driving and speeding, as the reasons. When respondents were asked about perceived threats to their safety, the top three threats—rated as "very serious"—were driving after drinking alcohol (90 percent), sending or reading text messages while driving (87 percent), and drivers not paying attention (79 percent), according to the report.

When asked about their driving behaviors over the past month, two-thirds of drivers stated that they talked on a cell phone while driving; 28 percent did so fairly often or regularly. Forty-four percent reported speeding 15 mph over the speed limit on highways, and 29 percent said they had run a red light even when it would have been possible to stop safely. Twenty-one percent of drivers reported text messaging while driving. Even though 95 percent of drivers deemed sending text messages while driving to be a completely or somewhat unacceptable behavior, nearly 20 percent of these drivers reported having read or sent a text message or e-mail themselves while driving. Similar scenarios were found with other behaviors such as red light running, speeding, tailgating, and talking on a handheld cell phone.

To see the report, visit tinyurl.com/AAAFTS report0709.

Alcohol, Drug Use by Drivers Declines

A survey by the National Highway Traffic Safety Administration (NHTSA), released in July, found a continued decline in the number of drivers impaired by alcohol on weekend nights. NHTSA's Traffic Safety Facts Research Note is the latest in a series of roadside surveys, conducted over four decades in 300 locations nationwide, that have measured weekend nighttime drivers' blood alcohol levels. The latest survey, from 2007, included for the first time data about drivers' use of potentially impairing drugs.

Since 1973, when the first of the four surveys was taken, the percentage of sampled drivers with blood alcohol content (BAC) over .08 has declined dramatically, from 7.5 percent to 2.2 percent. Although the percentage of underage drivers in fatal crashes with an illegal BAC increased from 1996 to 2007, the

(continued on page 34)

City of Norco, CA

Checkpoints for driver alcohol use also are reporting data on drivers' use of potentially impairing drugs.

(continued from page 33)
percentage of underage drivers with an illegal BAC has decreased since 1973.

Illegal drugs, as well as prescription and over-the-counter medications, were included in NHTSA's 2007 survey findings. According to the report, 16.3 percent of nighttime drivers had positive drug test results—however, this does not necessarily indicate impairment. The most commonly detected drugs were marijuana (8.6 percent of drivers), cocaine (3.9 percent), and methamphetamine (1.3 percent).

Additional research is needed to determine which drugs and dosage levels might impair driving. NHTSA is sponsoring a study to examine the link between drug use and involvement in crashes; results are expected in 2012.

INTERNATIONAL NEWS

Determining Crash Risk for Older Drivers

Age is not the sole determining factor of driver capacity, according to a study recently released by VTI, the Swedish National Road and Transport Research Institute. Commissioned by the Norwegian Public Roads Administration (Statens Vegvesen) and conducted in collaboration with TØI, Norway's Institute of Transport Economics, the report compiled and analyzed police-reported accidents in Norway, a literature study, and experimental studies in Norway and Sweden to identify hazardous situations for drivers age 65 and older and to examine visual behavior in these situations.

The VTI study found that the most frequent type of accident among older drivers occurs when the driver is making a left turn and is hit by another vehicle on the right or left side. Rear-end collisions—the most frequent among all drivers—are less common for older drivers, according to the report. Researchers found that older drivers had proportionately fewer accidents than younger ones in situations of inclement weather, poor visibility, or hazardous road conditions; this indicates that older drivers tend to avoid driving in these situations.

The study also reconsidered the assumption that advanced age naturally implies risky driving behavior. According to researchers, driving risk in the senior age group comes from two main causes—illness and fatigue. As a group, older people had more individual differences in driving capacity than younger people; subsequent methods to determine crash risk or unsuitable drivers must be refined beyond age groups, the study concluded.

For more information, see www.vti.se/EPiBrowser/Publikationer/R656ASve.pdf.

Aviation Group Sets Environmental Goals

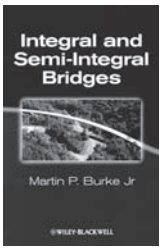
The International Air Transport Association (IATA) has set three environment-friendly targets for the aviation industry: by 2020, a 25 percent improvement in fuel efficiency from 2005; a 10 percent use of alternative fuels by 2017; and a 50 percent reduction in aviation emissions by 2050. IATA is developing a fourth target—a "carbon-neutral growth" date beyond which emissions will not increase, even with population growth.

According to IATA Director Giovanni Bisignani, aviation emissions will decline by 8 percent this year; although 6 percent of the drop is attributable to the recession, 2 percent is related to implementation of IATA's strategy, which incorporates technology, operations, infrastructure, and positive economic measures to reduce aviation emissions.

For more information, visit www.iata.org.

Giovanni Bisignani, Director General and CEO of IATA, opens the 65th IATA Annual General Meeting and World Air Transport Summit in Kuala Lumpur, Malaysia in June.

Integral and Semi-Integral Bridges



Martin P. Burke, Jr. Wiley–Blackwell, 2009. 255 pp.; $139.99; 978-140519-418-1.

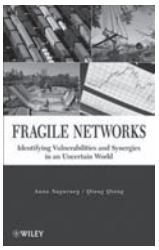
This book traces the evolution of deck-type highway bridges from the early 1930s to the present, focusing on subjects of significance to the design and construction of integral and semi-integral bridges. Also examined are the uncontrolled growth–pressure phenomenon, the culprit of much bridge damage; the attributes and limitations of integral-type bridges to be considered in the design process; the structure movement systems approach to highway bridge design; and some of the problem-solving techniques used by bridge design engineers. Real-life success stories and challenges—such as a bridge replacement and rehabilitation project in Ohio involving more than 1,800 bridges—provide insight.

Appendices to this volume include a critique of a formerly published and incorrect set of concrete pavement recommendations; a glossary to help novice engineers; and a collection of data and descriptions pertaining to the integral and semi-integral bridges shown in photographs throughout the book. Author Burke is an emeritus member of the TRB General Structures Committee.

Fragile Networks: Identifying Vulnerabilities and Synergies in an Uncertain World

Anna Nagurney and Qiang (Patrick) Qiang. Wiley, 2009. 313 pp.; $115; 978-0-470-44496-2.

Using a mathematical, multivariate approach, this book endeavors to help policy makers, urban planners, and business strategists identify critical infrastructure investment needs to bolster disaster preparation and mitigation. Computer-based network systems modeling and analysis methods are applied to vulnerabilities in congested urban transportation networks, logistical networks, supply chains, the Internet, and other systems.

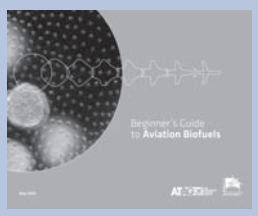


The authors explore many network activities: the behavior of network users, demands for resources, resulting flows, and associated costs. Three sections address network fundamentals, efficiency measurement, and vulnerability analysis; applications and extensions; and network integration, mergers and acquisitions, and areas of cooperation. Potential areas for risk reduction and disaster readiness are identified, along with possible synergies that can assist in disaster recovery.

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

The Beginner's Guide to Aviation Biofuels

Air Transport Action Group, May 2009. Available at www.enviro.aero/biofuels.



To advance the use of biofuels in aircraft, the Geneva-based Air Transport Action Group (ATAG) has published *The Beginner's Guide to Aviation Biofuels*. Unlike biofuels derived from food crops such as rapeseed and corn that are often unsuitable for use in aircraft, "second-generation" aviation biofuels are sustainably produced, meet performance and safety standards for aviation fuels, and are derived from nonfood crop sources that can be mass-grown in many geographic regions. Several airlines have successfully tested jet fuels from alternative sources such as camelina, jatropha, and algae. The pamphlet examines the key safety and technical criteria in the use of aviation biofuels, outlines the testing process currently under way, and looks at technical and sustainability challenges.

TRB PUBLICATIONS

Human Performance: Infrastructure, Information Systems, and Simulation

Transportation Research Record 2069

Authors study the effects of fog on car-following performance, run-off-the-road crashes involving overcorrection, the decision dilemma zone at a signalized intersection approach, two-way stop-controlled intersections on divided highways, left-turn warnings, auditory road safety alerts, wireless communication and entertainment devices' effects on driving, warning messages and variable speed limits, right-turning vehicles and pedestrians approaching from the right side, traveler information delivery mechanisms, and pretrip public transport information use.

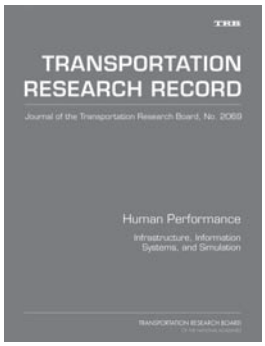
2008; 92 pp.; TRB affiliates, $40.50; nonaffiliates, $54. Subscriber category: safety and human performance (IVB).

Concrete Materials

Transportation Research Record 2070

Presented are papers on internal curing, impact echo scanning for void detection in posttensioned concrete, chloride permeability and microstructure of mortars incorporating nanomaterials, autoluminescent surfaces for concrete pavements, properties of concrete containing vitreous calcium aluminosilicate pozzolan, modulus contrast between near-surface material and deeper material in concrete pavements, the influence of curing conditions on strength development, and strategies for shrinkage mitigation.

2008; 67 pp.; TRB affiliates, $37.50; nonaffiliates, $50. Subscriber category: materials and construction (IIIB).



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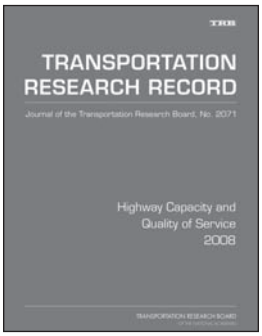


Highway Capacity and Quality of Service 2008
Transportation Research Record 2071
The 15 papers in this volume encompass subjects such as multimodal levels of service for urban streets, the impact of inclement weather on freeway traffic, an estimation of U-turn capacity at unsignalized intersections, delay estimation with oversaturated conditions, left-turn blockage and capacity models at a signalized intersection, the calibration of roundabout models, performance indicators for two-lane rural highways, unsignalized intersection delay, control-type selection at isolated intersections, driver behavior and gap acceptance at roundabouts, and actuated signal-controlled intersection capacity analysis with pedestrians.

2008; 130 pp.; TRB affiliates, $45; nonaffiliates, $60. Subscriber category: highway operations, capacity, and traffic control (IVA).

Transit: Marketing; Bus and Paratransit
Transportation Research Record 2072
Explored in this volume's 15 papers are transit issues, which include a farecard passenger flow model; mode shift from transit to single-occupancy vehicles on a high-occupancy toll lane; an automated bus origin–destination matrix; an in-vehicle interface design for bus collision warning systems; bus rapid transit systems in Latin America and Asia; the gap between public transportation vehicles and platforms, which can pose a barrier for the disabled; and the assessment of schedule qualities in paratransit.

2008; 147 pp.; TRB affiliates, $48; nonaffiliates, $64. Subscriber category: public transit (VI).

Pedestrians 2008
Transportation Research Record 2073
Video monitoring of pedestrians at signalized intersections, the characteristics and circumstances of collision-involved pedestrians, models to measure pedestrian activity at signalized intersections, walking speed of older pedestrians, the marked-crosswalk dilemma, detectable warnings for visually impaired pedestrians, Segway rider behavior, and other concerns of pedestrians are studied in this volume.

2008; 132 pp.; TRB affiliates, $45; nonaffiliates, $60. Subscriber category: safety and human performance (IVB).

School Transportation; Bicycles; Motorcycles and Motor Scooters
Transportation Research Record 2074
Authors examine institutional impediments to walking and bicycling to school; determining future school sites with land use data; effectiveness of school zone flashers; an analysis of traffic hazard intensity for urban bicyclists; child biking for nonschool purposes; bicycle facility planning; bicycle policy in Davis, California; cycling lessons from Europe; effects of increased sales of motor scooters and mopeds; and powered two-wheeler and passenger car free-flow speeds in urban areas.

2008; 84 pp.; TRB affiliates, $39; nonaffiliates, $52. Subscriber category: safety and human performance (IVB).

Operational Effects of Geometrics and Access Management 2008
Transportation Research Record 2075
Operating speed prediction for horizontal curves on rural four-lane highways; an assessment of curve severity and design consistency; the influence of horizontal alignment on operating speed of two-lane rural roads; the safety performance evaluation of highway intersections; the safety of center two-way left-turn lanes on two-lane roads; and the safety impact of access control standards on crossroads near interchanges are studied in this volume.

2008; 52 pp.; TRB affiliates, $35.25; nonaffiliates, $47. Subscriber category: highway operations, capacity, and traffic control (IVA).

Travel Demand 2008
Transportation Research Record 2076
Presented are papers on the impact of route choice set on route choice probabilities, the effects of policy on travel demand decisions under uncertain conditions, the integration of activity-based modeling and dynamic traffic assignment, a joint modeling analysis of trip-chaining behavior on round-trip commutes, an integrated analysis of toll lanes and bus priority lanes, the social context of activity scheduling, integrated transportation land use models, the influence of transportation access and market dynamics on property values, a toll demand model, and other subjects.

2008; 215 pp.; TRB affiliates, $52.50; nonaffiliates, $70. Subscriber category: planning and administration (IA).

Crosscutting Techniques for Planning and Analysis 2008
Transportation Research Record 2077
Authors present findings on subjects such as the integration of land use and transportation planning in the Netherlands, the statewide long-range transportation plan for Montana, best practices for traffic impact studies, public involvement in a proposed transportation project, the relationship between the built environment and travel behavior, transit-oriented development

TRB PUBLICATIONS *(continued)*

in China, modeling urban growth, transit path building, solutions for the sequential travel forecasting procedure using feedback, synthesized through-trip models for small and medium urban areas, and shifting modes of travel to national parks.

2008; 181 pp.; TRB affiliates, $51; nonaffiliates, $68. Subscriber category: planning and administration (IA).

Highway Safety: Planning; Young Drivers; Older Drivers; Indian Nations; Roundabouts; Traffic Law Enforcement; and Trucks and Buses
Transportation Research Record 2078
Safety-conscious planning in midsized metropolitan areas, driver injury severity factors in single-vehicle–deer crashes, detection of road hazards by novice teen and experienced drivers, the effect of passenger age and gender on fatal crash risks of young drivers, actual and perceived behavior of older drivers on freeways, spinal rotation during a driving task, an analysis of mobility policies for the elderly, crash reporting on Indian reservations, physical devices for slowing traffic in rural communities, automated speed enforcement programs, the effect of truck lane restrictions on freeways in mountainous areas, and other topics are explored in this volume.

2008; 142 pp.; TRB affiliates, 45; nonaffiliates, $60. Subscriber category: safety and human performance (IVB).

Pricing, Economics, and Finance
Transportation Research Record 2079
The 18 papers in this volume include topics such as pay-as-you-drive pricing, mileage-based road user charges, a vehicle-miles-traveled revenue collection system, a new road financing system for U.S. metropolitan areas, a municipal mobility manager, concession agreements for providing transportation infrastructure, public–private partnerships, value-capture mechanisms, transport project appraisal in Israel, and making the case for funding using results from performance measures.

2008; 153 pp.; TRB affiliates, $48; nonaffiliates, $64. Subscriber category: planning and administration (IA).

The TRR Journal Online website provides electronic access to the full text of more than 9,700 peer-reviewed papers that have been published as part of the Transportation Research Record: Journal of the Transportation Research Board *(TRR Journal) series since 1996. The site includes the latest in search technologies and is updated as new TRR Journal papers become available. To explore the TRR Online service, visit www.TRB.org/TRROnline.*

Traffic Signal Systems
Transportation Research Record 2080
Authors examine the highway–railway interface for the preempt trap, the effectiveness of lead–lag phasing on progression bandwidth, the integration of real-time pedestrian performance measures into traffic signal systems, microsimulation of split-cycle offset optimization technique and coordinated actuated traffic control, piecewise optimum delay estimation for improved signal control, variable maximum green time to improve rural traffic signal operations, traffic controller performance of coordinated actuated signal systems during time-of-day transition, robust synchronization of arterial actuated signals, and other topics.

2008; 119 pp.; TRB affiliates, $41.25; nonaffiliates, $55. Subscriber category: highway operations, capacity, and traffic control (IVA).

Construction 2008
Transportation Research Record 2081
Construction management, design–build project delivery, a construction quality index, streamlined strategies for highway rehabilitation, automated real-time three-dimensional location sensing, highway construction warranty specifications, the lives of deficient Superpave® pavements, dynamic cone penetration quality for cohesive soil embankment construction, and reconstruction of a damaged steel beam bridge are some of the subjects covered in this volume.

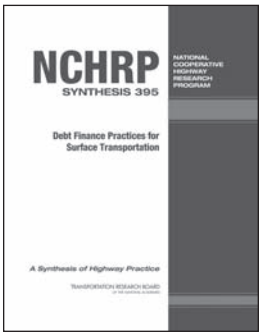
2008; 175 pp.; TRB affiliates, $51; nonaffiliates, $68. Subscriber category: materials and construction (IIIB).

Updated Test and Design Methods for Thermoplastic Drainage Pipe
NCHRP Report 631
This report contains the findings of research performed to develop a recommended load and resistance factor design (LRFD) specification for thermoplastic pipe used in culverts and drainage systems for highway structures. In addition to the recommended LRFD specification, the report features a quality assurance specification for manufactured thermoplastic pipe.

2009; 282 pp.; TRB affiliates, $54; nonaffiliates, $72. Subscriber categories: bridges, other structures, and hydraulics and hydrology (IIC); soils, geology, and foundations (IIIA); materials and construction (IIIB).

An Asset-Management Framework for the Interstate Highway System
NCHRP Report 632
A framework for applying asset management principles and practices to the management of Interstate Highway System (IHS) investments is outlined in this

TRB PUBLICATIONS *(continued)*

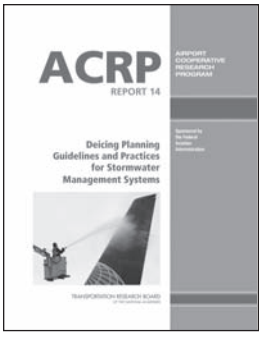


report. The IHS serves a large portion of the nation's highway transportation demand; the development of usable management principles and strategies for the system presents a challenge. The report describes the scope of this challenge and presents specific asset management practices that may be adapted for the IHS.

2009; 71 pp.; TRB affiliates, $34.50; nonaffiliates, $46. Subscriber category: planning and administration (IA).

Impact of Shoulder Width and Median Width on Safety
NCHRP Report 633
Of interest to transportation professionals responsible for geometric design and traffic operations, this report details research performed to quantify the safety and operational impacts of design element trade-offs and their associated risks. Recommended are specific crash prediction models and accident modification factors for shoulder width and median width on rural four-lane roads.

2009; 37 pp.; TRB affiliates, $28.50; nonaffiliates, $38. Subscriber categories: highway operations, capacity, and traffic control (IVA); safety and human performance (IVB).



Guidelines for Guardrail Implementation
NCHRP Report 638
Authors provide guidance on selecting the appropriate barrier performance level for the installation of longitudinal barriers. The report presents performance-level selection guidelines, as well as site-specific guidelines, to help identify the guardrail test level that should be incorporated and to determine when guardrail use is not cost-beneficial. Supplemental procedures for identifying appropriate guardrail test levels assist in expanding the applicability of the selection guidelines.

2009; 30 pp.; TRB affiliates, $27; nonaffiliates, $36. Subscriber category: highway and facility design (IIA).

Debt Finance Practices for Surface Transportation
NCHRP Synthesis 395
Presented are basic principles of debt issuance for public agencies, with a focus on the current practices of state agencies that are responsible for surface transportation investment. A literature review; a comprehensive survey of state departments of transportation; selected interviews; and a study of selected state policies, guidelines, and documentation provide guidance on the effective use of debt financing techniques to fund investments in transportation infrastructure.

2009; 84 pp.; TRB affiliates, $36.75; nonaffiliates, $49. Subscriber category: planning and administration (IA).

Transit, Call Centers, and 511: A Guide for Decision Makers
TCRP Report 134
This guide explores the operational characteristics of 511 systems—which disseminate traveler information by telephone—and examines how the systems interact with transit system call centers. Existing 511 systems throughout the country are examined, transit agency experiences with and participation in 511 are documented, and guidance is presented to assist transit agencies and 511 system administrators in determining a strategy for transit and 511 to work together.

2009; 89 pp.; TRB affiliates, $38.25; nonaffiliates, $51. Subscriber categories: planning and administration (IA) and public transit (VI).

Controlling System Costs: Basic and Advanced Scheduling Manuals and Contemporary Issues in Transit Scheduling
TCRP Report 135
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Equity of Rail Investments

Sandra Rosenbloom's essay, The Equity Implications of Financing the Nation's Surface Transportation System (*TR News*, No. 261, March–April 2009, pp. 3–9) speaks to a most current topic. She notes, however, that poor people tend to use buses, while the rail modes serve the wealthy. When rail service is available to the poor, they use it more than they use buses. National data are misleading, because many smaller cities have no rail transit. Typically, 55 percent of bus riders may be low income, but only 45 percent of rail riders may be low income. Annual per capita rail ridership may be 890 passenger-miles—as in Washington, D.C.—but bus ridership is only 278 annual passenger-miles per capita. The poor travel 400 annual passenger-miles per capita by rail, but only 152 by bus (*1*).

The article also notes that rail transit is more costly than bus, primarily because of capital investment. This may be true for some systems, but not for most. In 2007, rail transit averaged a cost of 37.6 cents per passenger-mile, and bus transit averaged 77 cents. In large cities with rail transit, some bus operations cost more than $1 per passenger-mile in 2007 (*1*). Moreover, according to accountants, capital investment is not an expense, but an asset. The cost—called depreciation—comes when the asset is used.

In the national capital area, for example, roughly $11 billion has been invested in the Metrorail system, parts of which are now 33 years old. Depreciation is about 2.5 percent, equal to $275 million per year or 17 cents per passenger-mile. Added to the operating cost, the full cost is 61 cents per passenger-mile, but bus costs were $1.17 per passenger-mile, plus depreciation of about 16 cents, for a total of $1.33 per passenger-mile—almost equal to taxi costs (*2*). Saving 72 cents per passenger-mile benefits rich and poor alike.

There is more to consider. The national capital area consumes 350 gallons of motor fuel per capita, similar to New York City with its subway and commuter rail systems. The national average is 580 gallons per capita, similar to large cities with no rail transit (*3–5*). With petroleum at $2.50 per gallon, that is worth $1 billion a year per city, less $67 million for the electricity to run rail (*1*). That is absolutely equitable for all citizens—although not possible without public funding of capital investment.

—E. L. Tennyson
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2. Figures derive from professional experience with Metrorail as consultant to the National Capital Transportation Agency; as Public Works Planning Coordinator for Arlington County, Virginia; and as Chair, Chief Administrative Officers' Metro Budget Review Committee.
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Oregon's Definition of Equity

Sandra Rosenbloom's article, The Equity Implications of Financing the Nation's Surface Transportation System, is informative and well done. In Oregon, we also consider equity among highway user and vehicle classes, based on the costs attributable to vehicles of differing sizes, weights, and other operating characteristics.

The principle of cost responsibility—that payments from transportation system users should be in direct proportion to the costs they impose on the system—has served as the cornerstone of Oregon highway finance for more than 70 years. Under this definition of equity, the fairness of any highway taxation structure is measured by how well payments from each vehicle class match the costs associated with the use of the highway system by that class. Typically applied to highways, this principle is equally relevant to other transportation modes.

Oregon conducts periodic studies to quantify and compare the responsibilities and revenue contributions of light vehicles up to 10,000 pounds and heavy vehicles of 10,000 pounds or more. Since 1999, the state constitution has required that these studies be conducted biennially and that highway user tax rates be adjusted, if necessary, to ensure "fairness and proportionality" between the major vehicle classes. This tradition has served the state well by ensuring that highway taxes and fees are levied in an equitable and efficient manner. This has provided all highway users with a common basis to support needed increases in transportation funding.

—John Merriss
Manager, Highway Cost Allocation Studies
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Sandra Rosenbloom replies:

As John Merriss notes, Oregon is a recognized leader in addressing equity issues in highway finance. But weight differences are not the only way in which vehicles and drivers can have an unfair impact on the highway system. Two federal commissions have con-

cluded that fuel excise taxes do not charge drivers fairly for the congestion or pollution costs that they impose on others (*1, 2*).

E. L. Tennyson covers many issues, but the most relevant is the income of rail riders versus bus riders. The data on which he bases his analyses, however, are not available from the sources he cites—for example, the National Transit Database (NTD) does not contain ridership information by income.

In contrast, working from a compilation of 150 onboard surveys taken between 2000 and 2005, the American Public Transportation Association found that more than 43 percent of riders on roadway transit modes had incomes under $25,000, and less than 12 percent had incomes of $75,000 or more. Conversely, less than 21 percent of rail riders had incomes under $25,000, and more than 30 percent had annual incomes of more than $75,000 (*3*). National Household Travel Survey data from 2001 show similar modal differences by income (*4*).

I agree that the focus should be on ridership data from systems with both rail and bus services, but those data are difficult to obtain. The Los Angeles Metropolitan Transit Authority, however, recently reported that in 2002 the annual income of an average rail rider was 83 percent more than that of its average bus rider (*5*).

Calculating ridership costs only from annual operating data makes rail expenditures look far more cost-effective than they are. For illustration, I combined NTD capital data with operating data for 2007 to compute ridership costs by mode for the 10 largest systems: Baltimore, Boston, Chicago, Houston, Los Angeles, New York City, Philadelphia, San Francisco, Seattle, and Washington, D.C. (*6*).

In six of these systems, an average bus trip was less expensive than all forms of rail trips; in Houston, the average light rail trip cost 270 percent more than the average bus trip ($12.32 versus $3.33). In only four of the transit systems was the cost of providing a bus trip more than that for providing some rail trips: Boston, Los Angeles, New York City, and Seattle—and the differences often were small. In Los Angeles, the average bus trip was $2.55, the average heavy rail trip, $2.41, and the average light rail trip, $9.73. In New York, the average bus trip was $2.66 versus $2.20 for heavy rail. (Calculations are available on request.)

The figures suggest that a few older rail systems tend to have average costs lower than those for buses because rail carries a meaningful share of total ridership in those cities. That is rarely true of newer systems.

Depending on the subsidy per trip by mode—that is, the gap between costs and fares—poorer riders may subsidize wealthier riders directly or receive lower-quality service because rail services capture a disproportionate share of the budget. Those issues are at the heart of many lawsuits filed against proposed rail services by ethnic and racial groups (*7–9*).

Even were rail investments to reduce congestion, energy consumption, or pollution, serious equity issues remain. At a minimum, we must question (*a*) if and when providing either rail or bus services offsets any inequities in highway financing, and (*b*) if it is equitable to fund rail systems at the expense of the bus services on which so many poor people depend.

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