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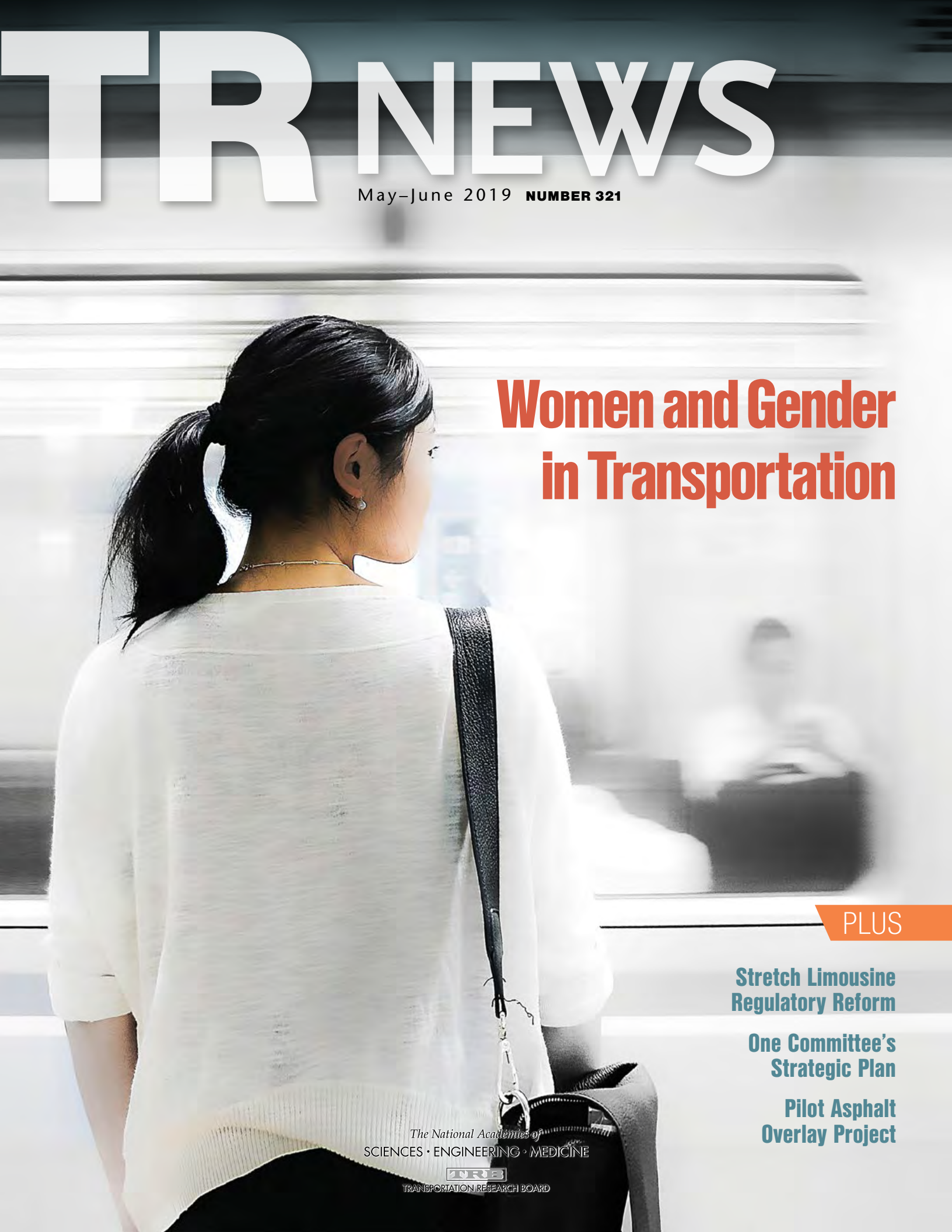

Women and Gender in Transportation

PLUS

Stretch Limousine Regulatory Reform

One Committee's Strategic Plan

Pilot Asphalt Overlay Project

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* Membership as of May 2019.

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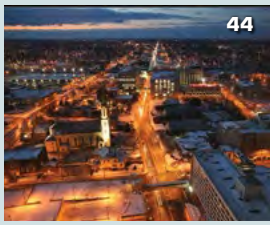

3 Women and Gender in Transportation: Better Transportation for Women Benefits All

Dawn Hood and Tara Goddard

The majority of the articles in the May–June issue of *TR News* highlight women and gender in transportation. Focusing on and improving transportation for women not only advances the interests of women but also leads to better health, safety, and economic outcomes for all travelers and their communities.

5 Women's Issues in Transportation Conference
Therese W. McMillan and Asha Weinstein Agrawal

6 Women's Constrained Travel Behavior: Austrian Case Study

Juliane Stark and Michael Meschik

When someone feels unsafe, it can affect their travel intentions, behavior, and patterns. This constrained travel behavior—which manifests variously as avoiding certain modes, changing routes, and employing self-defense measures—is still a fairly unexplored topic. The authors present the methodology and findings of their study, based in Austria, of the ways in which harassment, assaults, and other frightening situations have affected women's travel behavior.

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Winnie Okello

12 Challenges of Bicycling and Walking Faced by Minority Women in Low-Income Communities

Wesley Blount, Jr.

As a fast-growing segment of the cycling population, bicyclists of color are becoming an increasingly powerful and visible constituency. This article examines initiatives and campaigns to strengthen bike cultures for low-income and minority populations, as well as the challenges, both practical and structural, along the way.

15 Transformational Technologies' Impact on Women

Maria Cristina Marolda

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Technology for All: How Equity, Access, and Affordability Must Feature in Next-Generation Vehicle Policy

Monica G. Tibbits-Nutt

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Sheila Mitra-Sarkar and Floridea Di Ciommo

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27 Current Women Leaders in Transportation
Katherine Kortum

28 Women Transportation Pioneers
Winnie Okello

COVER Addressing the needs of women and gender in transportation leads to a more efficient and equitable system for all travelers. (Photo: Pixabay)

30 Tragedy in Schoharie, New York, and Stretch Limousine Regulatory Reform

Matthew W. Daus

A 2018 limousine crash in Schoharie, New York, killed 20 people in one of the deadliest transportation disasters in nearly 10 years. The author examines the implications of the crash, legislative and policy responses, and possible next steps to increase limousine safety, as well as stretch limo industry trends and safety protocols and regulations.

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Christopher Porter, Douglas Eisinger, Shams Tanvir, and David Kall

As new technologies like cloud computing and vehicle electrification transform transportation air quality research, the TRB Standing Committee on Transportation and Air Quality used the changes to reexamine the information needs of planning agencies and other stakeholders and to recalibrate its activities. This article shares the committee's recent efforts and planned future work.

41 High-Performance Thin Asphalt Overlay Rises to Challenge: Pilot Project in Manhattan

Frank Fee

Planners in New York City faced a challenge along First Avenue, one of the city's major thoroughfares, which was in poor condition from years of utility projects and repairs. An upgrade project to add a bus lane and separated bike lanes would require the costly rehabilitation of 53 city blocks in an already-congested, busy area. The author outlines the progress and success of a pilot project to use high-performance thin overlay material to rehabilitate First Avenue in less time and for much less money.

44 RESEARCH PAYS OFF
DamageWise Program Implementation Pays Off for Indiana

Daniel L. Brassard, Deborah Horton, and Darcy M. Bullock

Coming Next Issue

The July–August 2019 issue of *TR News* focuses on types of trespassing in passenger and freight rail: the importance of the issue, possible strategies to prevent trespassing, and effects on the rail transportation system. Articles will present an overview of the prevalence of trespassing deaths and will address a variety of preventive strategies and technologies as well as related research.

Photo courtesy Asim Zaman

A school bus crosses a railroad intersection as the gates are closing. The July–August 2019 issue of TR News *examines many aspects of railroad trespassing, such as the use of artificial intelligence–aided detection data to study trespassing incidents.*

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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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Women and Gender in Transportation

Better Transportation for Women Benefits All

Welcome to the *TR News* special issue on women and gender in transportation. Although this issue focuses on women's perspectives, the articles merit your attention. Addressing transportation issues that specifically affect women benefits everyone, regardless of gender. Focusing on and improving transportation for women is the right thing to do—and often results in significant positive health, safety, and economic outcomes.

Why should you pay attention to transportation issues faced by women?

- In most societies—even the ones in which women participate in the workforce at near-equal rates to men—women tend to be responsible for household- and child-related travel.
- Women most often act as caretakers of aging family members—a demographic on the rise.
- Twelve percent of women in metropolitan areas and more than 17% of women in rural areas have a disability; this represents a significant intersection of travel issues related to women and to people with disabilities.[1]
- U.S. women comprise 47% of workers, are the primary or sole earners in 40% of households with children, and own nearly 10 million businesses, accounting for $1.4 billion in annual revenues.[2]

Photo: VDOT, Al Covey

Tackling equity in transportation includes examining access disparity, including global policies, legal approaches, and practical applications.

These examples of how gender is relevant to a wide variety of transportation fields explain both the origin and the mission of the TRB Standing Committee on Women's Issues in Transportation. Born out of a safety and data committee, the group's work has expanded beyond gender differences in crash risks, rates, and outcomes to address the major and enduring differences between women and men in travel behavior, preferences, and attitudes; crash risks and outcomes; responses to

[1] Based on American Community Survey 5-year data.
[2] Based on U.S. Department of Labor data.

Photo: Tom Page, Flickr

Passengers wait in a Vienna, Austria, Metro station.

the construction and operation of various transportation and freight vehicles; concerns about safety (crashes and falls) and personal security (crime and harassment) in all transportation modes; responses to transportation and related public policies, incentives, and sanctions; and participation and experiences in various sectors of the transportation labor force.

The variety of article topics in this issue reflect the goals and objectives of the Women's Issues in Transportation Committee. Juliane Stark and Michael Meschik present an international perspective, examining a case study from Austria on women's travel constraints. Winnie Okello shines a light on issues of harassment on the street and on transit. Demonstrating that women's identities are intersectional, Wesley Blount illuminates the challenges that minority, low-income women face as pedestrians and bicyclists. Cristina Marolda considers how transformational technologies affect women in several major transportation fields.

For more than four decades, the Women's Issues in Transportation Committee has illuminated the importance of gender differences in all aspects of transportation—but its work is not done.

Stated equity goals at every level of government mean that emergent technologies must also include a consideration of gender, observes Monica Tibbits-Nutt. Similarly, data collection historically has neglected women, note Sheila Mitra-Sarkar and Floridea Di Ciommo in their article on mainstreaming gender data collection. Therese McMillan and Asha Agrawal share information about the upcoming 2019 Women's Issues in Transportation Conference—a chance to learn more about all these topics and to network with professionals from all over the world.

For more than four decades, the Women's Issues in Transportation Committee has illuminated the importance of gender differences in all aspects of transportation—but our work is not done. We need your involvement to continue making progress, because a focus on women's transportation relies on allies in all facets of the profession, regardless of gender or specific field.

We hope that you enjoy this special issue of *TR News* and come away with a deeper understanding of the many ways we can all care about transportation issues that affect women.

—Dawn Hood and Tara Goddard
Chair and Member, TRB Standing Committee on Women's Issues in Transportation

NOTE: The *TR News* Editorial Board thanks Katherine Kortum for her work assembling and developing this issue.

Women's Issues in Transportation Conference

THERESE W. MCMILLAN AND ASHA WEINSTEIN AGRAWAL

McMillan is Executive Director, Metropolitan Transportation Commission, San Francisco, California, and Agrawal is Education Director, Mineta Transportation Institute, San Jose State University, California.

In September 2019, TRB will host the 6th International Conference on Women's Issues in Transportation (WIiT). Building on the themes explored in the first conference in 1978 and subsequent meetings, the 2019 WIiT will bring scholars and practitioners together at the Beckman Center in Irvine, California, to examine all aspects of women's experiences in travel and transportation.

Picking up themes of previous WIiTs—especially the fourth conference, held in Irvine in 2009—the 2019 conference is organized around an evaluative framework of three lenses: insights, inclusion, and influence.

- ***Insights***
  What have we learned in the 10 years since the 2009 WIiT in Irvine and how do those insights guide us to the next key areas for research and action? For example, what issues remain relevant today and what issues require a different approach? How do new developments, particularly in technology, affect women's travel and participation in the transportation workforce?
- ***Inclusion***
  Has the push to advance the needs of women opened up a wider lens to gender equality? For example, should TRB's conferences and committees retain their emphases on how transportation impacts women or should future research and practice shift to a broader focus on gender, one that explicitly incorporates the challenges faced by LGBTQ and other communities?
- ***Influence***
  If there appears to be an unacceptable rate of change based on gender, why is that? For example, in what aspects of transportation has progress occurred on matters of concern to women? What might be new areas of research—or ways of presenting research findings—that can move the needle to exact more dramatic change?

The most recent WIiT was held in 2014 in Paris, France, and called for bridging the gap between men and women, between rich and poor countries, and between knowledge and policy. Media trends in recent years have placed attention on these differences, particularly those between women and men, as seen through hundreds of women's marches, studies in workforce disadvantages, and the #MeToo movement.

Despite so much public interest and attention to gender equality, however, limited attention is paid to understanding the major obstacles and constraints encountered by women travelers and women who work in transportation industries. WIiT will spotlight and explore in depth the needs and opportunities to use research to improve policies, actions, and outcomes for women and others facing gender-based disparity in transportation.

The 2019 WIiT will include many activities to connect students and emerging professionals with more seasoned practitioners and scholars, for the mutual learning of all. One innovative experience planned is a marquis dinner, cohosted with the Women's Transportation Seminar, that will bring academics, practitioners, and students from the high school to doctoral levels together in conversation.

For more information about the conference, please visit www.cvent.com/events/6th-international-conference-on-women-s-issues-in-transportation/event-summary-c01736980c964d-8093c8e32fc031e3b2.aspx.

Women's Constrained Travel Behavior

Austrian Case Study

Photo: PxHere

JULIANE STARK AND MICHAEL MESCHIK

The authors are Senior Scientists, University of Natural Resources and Life Sciences, Department of Landscape, Spatial, and Infrastructure Sciences, Institute for Transport Studies, Vienna, Austria.

Above: The Vienna U-Bahn station in Austria. A new study examines the situations women encounter in traveling and how behavior is modified in response.

Fear about personal safety on different modes of transportation—and traveling to and from these different modes—is a significant issue for children, the elderly, persons with disabilities, ethnic and racial minorities, and women. This article focuses on safety issues specific to women.

Safety-related risk perception can impede travel patterns as well as the intention to travel independently. Constrained travel behavior can be expressed in a variety of ways; for example, women may avoid certain trips and travel modes and might change their destinations and routes (*1*). Those behavioral adaptations can be dependent on the time of day; more specifically, they often are based on lighting conditions, not only daylight but also artificial light in buildings. To cope with fear and to increase perceived safety, women sometimes employ a strategy of "arming measures," which includes carrying items for self-defense, such as pepper spray, pocket alarms, or knives; holding or using a mobile phone while walking alone; or attending a self-defense course.

Photo: Tom Page, Flickr

Women often avoid travel modes in which lighting may not be adequate, both outside at night and inside building and transit stations.

Methodology

The constrained travel behavior of women still is an underresearched topic. Few studies have quantified the impacts of fear and personal safety on different modes of transportation. An Austrian study investigated how the situations that women had faced in their everyday mobility, such as harassment and assaults, had affected their travel behavior (*2*; see box below).

To investigate how women's mobility is affected, researchers used the term "frightening situations" to describe the experiences that caused women to alter their travel behavior. It must be stated that objectively similar situations can, of course, cause different impacts; therefore the objective seriousness of an incident was not really relevant for this study. In 2012 and 2013, 402 interviews were conducted via two telephone surveys to investigate the degree of constraint in the travel behavior of women in Austria.

The researchers' main objective was to assess how many women experienced frightening situations while traveling; the locations and circumstances of those situations; and, if applicable, women's responses. The first survey was an exploratory study to identify what kind of situations took place and where. The second survey mainly addressed the proportion of women who experienced frightening situations.

The questionnaires consisted of three parts. The first part included general questions like sociodemographic characteristics, the respondent's self-reported general communicativeness and anxiety levels, and screening questions to identify if women were affected. Whether or not they had experienced frightening situations in their everyday mobility, respondents reported individual safety precautions they have taken, such as avoiding certain walking routes, and whether they changed their travel modes based on the time of day.

NOTE: This article presents an excerpt of study results. It is based on the authors' 2018 paper, "Women's everyday mobility: Frightening situations and their impacts on travel behaviour" (*2*).

Photo: Yuan, Flickr

An Austrian survey on mobility behavior examined how many women had experienced frightening situations on transit.

The second part included questions about the situations, including the environment, the travel modes used, and the time of day. The final part of the questionnaire was directed only at women who had experienced a frightening situation and included questions on changes in their travel habits based on the frightening situations they had experienced.

Results

The results showed that, overall, one-third of women had experienced frightening situations while traveling. Among these women, 13% had experienced one situation and 21% had experienced between two and five situations. These results may not be generalizable, however. A much older study in the United Kingdom revealed that 31% of respondents had been harassed and that about one-quarter had been harassed more than once (*3*).

In further analysis, 171 frightening situations were broken up into 230 subactions that then took place; for example, if a woman experienced both a verbal harassment and an attempted assault (Figure 1, below). Most of those incidents included verbal (42%) and nonverbal (20%) harassment; followed by attempted assaults (16%);

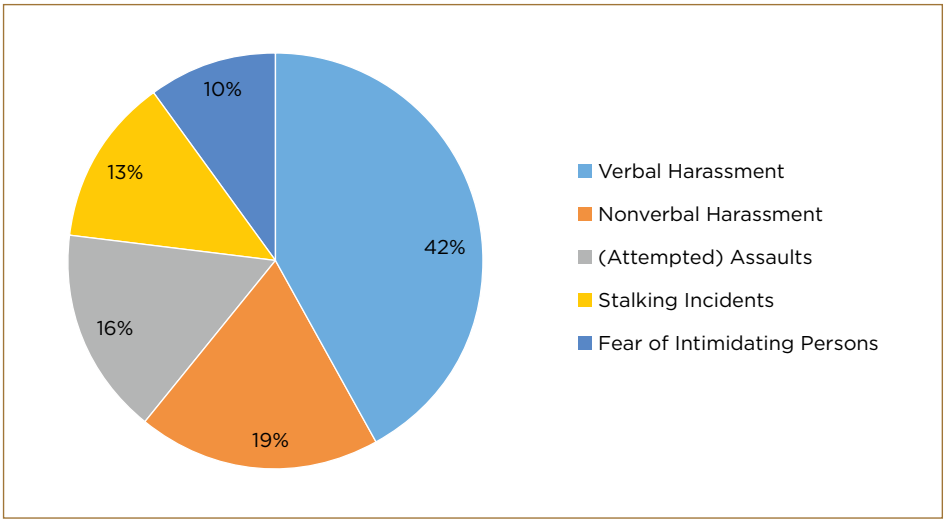

FIGURE 1 Frightening situations experienced by women. (N = 230 subactions of 171 incidents.)

stalking (12%); or the fear of intimidating persons, that is, fights at public transport stops, groups of intoxicated persons in the metro, or men approaching on a deserted street (10%).

Some of the reported situations occurred inside vehicles (27% of all situations), but the majority (73%) occurred outside vehicles; 36% of situations occurred within the urban area. In most cases, women were walking at the time of the incident; the next most common thing women were doing at the time of the incident was riding on public transit. Other persons were present in half of the cases; a high proportion of incidents happened inside crowded vehicles.

The results showed that most respondents regularly take precautions when traveling, avoiding routes, stations and destinations, and travel modes, to try and prevent frightening situations. The share of women taking at least one arming measure was significantly higher if the respondent had already experienced a frightening situation (96%) compared with women who had not experienced one (78%), and this share varied depending on the time of the day.

In total, 75% of all women who had been affected by frightening situations avoided certain routes or destinations, such as spaces with dim lighting and underground car parks and railway stations. The avoidance of specific travel modes is not as widespread, but 39% of affected women and 16% of nonaffected women try to avoid specific modes of transportation—mainly public transit, specifically subways, railways, trams, and buses. The results suggest that the percentage of women who avoid specific travel modes, always or at least partly dependent on the time of day, doubled among women who had had negative experiences while traveling.

Other modes, such as bicycles, taxis, and cars received fewer mentions; traveling inside a vehicle or on a bicycle creates less exposure to potential offenders (*2*). This also is supported by the finding that women feel less vulnerable riding a bicycle than walking in darkness, presumably because of the higher velocity and because they can keep away from sidewalks.

Photo: FaceMePLS, Flickr

According to the Austrian study, fewer negative experiences occur on modes with less exposure to potential offenders, such as riding a bicycle or driving a car.

Conclusion

The Austrian case study confirms that women in general have constrained travel behavior because of fear for their personal safety. When it is not possible to change the travel route or the travel time, or when no other transport mode is available, women feel that they must use less desirable transportation options—even if it means they may encounter frightening situations.

Women's sense of personal security plays an important role in their travel behavior. The share of women affected by frightening situations while traveling translates to unequal mobility opportunities that can result in social exclusion. Because, as suggested in Armitage and Gamman (*4*), personal safety and fear of crime is one of the main components for sustainability frameworks, safe environments in which all people can move about freely and without fear are essential.

Photo: Alper Cugun, Flickr

Surveys showed that a high portion of frightening situations occurred inside crowded transit vehicles.

REFERENCES

1. Loukaitou-Sideris, A. What Is Blocking Her Path? Women, Mobility, and Security. Presented at 4th International Conference on Women's Issues in Transportation, Irvine, California, 2010.
2. Stark, J., and M. Meschik. Women's everyday mobility: Frightening situations and their impacts on travel behaviour. *Transportation Research Part F: Traffic Psychology and Behaviour*, Vol. 54, 2018, pp. 311–323, 2018. https://doi.org/10.1016/j.trf.2018.02.017.
3. Lynch, G., and S. Atkins. The influence of personal security fears on women's travel patterns. *Transportation*, Vol. 15, No. 3, 1988, pp. 257–277. https://doi.org/10.1007/BF00837584.
4. Armitage, R., and L. Gamman. Sustainability via security: A new look. *Built Environment*, Vol. 35, No. 3, 2009, pp. 297–301.

Photo: Devin Smith

Street and Transit Harassment

Discussions of transportation safety topics typically include the following issues: mechanical features, sight distance, roadside hazard minimization, planning tools, and even inclement weather considerations. The topic of personal security and safety, however, typically focuses on terror prevention or national security threats; gender rarely is a consideration. Only recently has some attention to gender concerns begun to circulate in the design process: where should transportation safety begin—when a person is walking to the public transit or when they are waiting at the designated station? What efforts can be made to ensure a greater sense of safety to users as they navigate various public spaces?

According to the World Bank 2017 Global Mobility Report, "women's mobility is of concern in rural and urban areas," especially in those with limited access to public transportation, and "although no database on public transit-related crimes is available, evidence points to security issues that constrain women's mobility" (*1*). These security issues limit where and how far women can travel, the times of day women can safely use transit systems, and women's access to financial stability and independence. A lack of personal security, either real or perceived, or the inability to use transportation without the fear of being victimized—whether riding public transportation, walking to or from a facility or stop, or waiting for transit—can substantially decrease the attractiveness and use of public transit (*1*).

Studies have shown that women experience more street harassment than men (*2–3*). Typical street harassment includes, but is not limited to, leering, honking, whistling, sexist comments, vulgar gestures, sexually explicit comments, kissing noises, unwelcomed following, blocking of pathways, and even assault. Street and transit harassment include unwanted and annoying actions of one party or group to another, threats, and demands, whether systematic or continued or both.

Typical street harassment includes, but is not limited to, leering, honking, whistling, sexist comments, vulgar gestures, sexually explicit comments, kissing noises, unwelcomed following, blocking of pathways, and even assault.

Photo: KeioLine, Wikimedia

Single-sex train carriages in Japan were instituted to reduce incidents of harassment.

Fear of crime and violence has been documented consistently as more pronounced among women than men. Women tend to consciously monitor the public spaces they navigate for environmental cues of danger and to change their behavior in response to feelings of unsafety, such as avoiding particular areas, traveling with company, keeping a friend updated on one's whereabouts, and carrying pepper spray or other personal safety devices (*3–4*).

Victims may not report incidences of harassment out of fear, shame, or guilt. Society often has placed the onus of harassment prevention on the victim rather than on the abuser; for instance, victims often are told that their attire and public interactions with strangers could invite harassment. In an effort to reduce public transit harassment and invasion of women's personal spaces, some countries such as Mexico, India, Japan, and Brazil have implemented women-only cabins (*3*). Such arrangements seem like a viable, pragmatic solution, but they may send the message that women who do not want to be harassed should separate themselves and that women who choose to travel in the regular cabins should expect some harassment.

In 2000, nearly 70% of women in Tokyo backed the women-only cabins that were introduced to reduce incidents of harassment and increase safety and comfort for female passengers (*5*). But as Telegraph writer Claire Cohen argues, single-gender arrangements may normalize sexual assault; rather than remove women from the equation, the answer is to tackle the problem of sex offenders (*3*).

Although issues of street and transit harassment seem to have more to do with human behavior, addressing them demands equal participation by the technical community. Engineers, architects, planners, and policy makers must collaborate to create implementable practical solutions. It is imperative to understand the human element of engineering, and design accordingly to best suit the end users. Safety features such as well-lit walking paths and transit waiting areas protected from the elements, spacious travel cabins, stricter background checks, easier-to-use incident reporting systems, and security features such as recording devices can make transit systems users feel safer and more secure.

Ridesharing

Infrastructure alone cannot solve the issue at hand. Rideshare services such as Uber, Lyft, Moovel, ARRO, and Bolt, as well as traditional taxis, also may help tackle harassment and safety concerns. Rideshare services can provide an increased sense of safety, allowing passengers access to vehicle and driver information before pick-up as well as shareable trip status updates once the ride begins. Although most harassment in general goes unreported, data collected from transit-related reported incidents do influence company culture and policies and aid in implementing proactive solutions to minimize and eliminate future occurrences (*6*).

Following a recent media spotlight on harassment and assault cases related to the use of rideshare apps, Uber has made strides toward greater transparency by partnering with the National Sexual Violence Resource Center (NSVRC) and the Urban Institute to

create a new taxonomy to categorize reported incidents of sexual misconduct and sexual assault (*7*). The listed categories include, but are not limited to: staring or leering, comments or gestures, attempted touching or kissing, nonconsensual touching or kissing, and soliciting sexual acts. Mainstream media outlets have brought these conversations on rider safety and awareness to the forefront as well as the emergency features currently available in these apps as more victims share unwelcomed experiences.

Some rideshare apps such as Safr, DriveHER, and Ride Austin operate with the premise of providing increased safety features especially for female passengers: stricter vetting procedures, bystander awareness training, and around-the-clock, real-time monitoring. According to one study, "when it comes to the person behind the wheel, women riders want women drivers. Nearly 45 percent prefer female drivers. Only nine percent want male drivers and 46 percent have no preference" (*8*).

Major competitors such as Uber and Lyft also have taken measures to bridge the gender-related safety gap by implementing stricter screening technology and policies; working with law enforcement and transportation leaders to minimize future incidents; implementing a dedicated critical response line for emergency assistance; eliminating forced arbitration for individual claims of sexual assault and harassment; committing to release transparency reports; and creating a taxonomy to better classify sexual assault and misconduct claims.

Transportation-related and street harassment is a significant issue, especially for the many women who require public transit to navigate their daily commutes to and from work, home, doctors' appointments, and more. It is imperative that all involved in the policy, planning, design, and implementation process to consider gender-related safety concerns more seriously to facilitate a safer transit experience for all commuters—especially women and other vulnerable demographics.

Photo: Dakota Grizzle, Pexels

In ridesharing, women generally prefer women drivers.

The positions expressed in this article are those of the author and do not necessarily reflect the official policy or positions of the Pennsylvania Department of Transportation.

—Winnie Okello, Senior Civil Engineer, Transportation, Pennsylvania Department of Transportation, Harrisburg

REFERENCES

1. Sustainable Mobility for All. Global Mobility Report 2017: Tracking Sector Performance. 2017. http://documents.worldbank.org/curated/en/920101508269072500/pdf/120500-REPL-PUBLIC-GM-Report-2017-Online-04-06-18.pdf.
2. Stop Street Harassment. Statistics: The Prevalence of Street Harassment. www.stopstreetharassment.org/resources/statistics/statistics-academic-studies.
3. Cohen, C. Women-only train carriages: Keeping women 'safe' by separating them from men is Handmaid's Tale territory. Telegraph. Aug. 23, 2017. www.telegraph.co.uk/women/life/women-only-train-carriages-keeping-women-safe-separating-men.
4. Paddison, L. Women around the world are harassed and abused on public transportation. HuffPost. Oct. 19, 2017. www.huffpost.com/entry/women-public-transportation-harassment_n_59e88cfee4b0d0e4fe6d8202.
5. Reid, M., and B. L. Yi. 70% of women in Tokyo back single-sex transport amid safety concerns. World Economic Forum. Nov. 21, 2018. www.weforum.org/agenda/2018/11/women-in-tokyo-strongly-back-single-sex-transportation-amid-security-fears.
6. Castillo, M. Ride share apps don't publicly disclose cases of sexual assault. That's a big problem. The Lily. May 1, 2018. www.thelily.com/ride-share-apps-dont-publicly-disclose-cases-of-sexual-assault-thats-a-big-problem.
7. National Council for Home Safety and Security. Nearly a quarter of women have turned in Uber drivers for uncomfortable behavior. 2018. www.alarms.org/uber-lyft-womens-safety-report.
8. Sniffen, C., J. Durnan, and J. Zweig. Helping industries to classify reports of sexual harassment, sexual misconduct, and sexual assault. National Sexual Violence Resource Center, Harrisburg, Pennsylvania, 2018. www.nsvrc.org/sites/default/files/publications/2018-11/NSVRC_HelpingIndustries.pdf.

Challenges of Bicycling and Walking Faced by Minority Women in Low-Income Communities

Photo: Black Girls Do Bike

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Above: *Members of Black Girls Do Bike (BGDB), an organization supporting and encouraging women and girls of color in cycling. Initiatives across the country involve minority women in bicycling.*

Communities of color are embracing cycling, and as a fast-growing segment of the cycling population, they are making themselves far more visible (*1*)—especially minorities in low-income communities.[1] Groups that previously were underrepresented in cycling are forming an increasingly powerful and growing constituency, cultivating new campaigns and bike cultures that address their needs and that improve the health and safety of all residents who ride or want to ride.

One group, Black Women Bike: DC, comprises 800 women—a true cycling movement. Like Black Women Bike, other groups such as We Bike NYC provide a safe space for women to ride together, regardless of skill, speed, or riding style.

Challenges

Many efforts have been made to involve minority women in transportation to better reflect their needs, such as a focus on environmental justice and resources offered by the American Association of State Highway and Transportation Officials. In response, bicycle advocacy organizations, such as the Washington Area Bicyclist Association, are working to change the perception of biking in their communities and to encourage people to hop on a bike and have fun, build life skills, and develop relationships with friends and the community.

One example is the Girls Bike Club, created by a group of female high school students in Chicago participating in a summer apprenticeship. Now a part of West Town Bikes Club, Girls Bike Club created a welcoming space for young women of color to plan rides together, make jewelry from bike parts, and set time aside for homework help (*3*).

[1] The Federal Highway Administration's definition of minority is as follows: "Belonging to a racial or ethnic group including black, Hispanic or Latino, Asian-American, American Indian and Alaskan Native, and Native Hawaiian or other Pacific Islander." (*2*) Note that some people and organizations believe that the term "minority" is inappropriate and prefer terms such as "communities of color" or "people of diverse backgrounds."

Photo: Dakota Grizzle, Pexels

For some women, "helmet hair" and other practical concerns can create barriers to wearing helmets and ultimately to cycling.

Photo: Black Girls Do Bike

BGDB participated in the Tour de Cure to fight diabetes. Bicycling not only decreases the risk of health concerns, it also helps build communities and social connections.

Issues that may arise in low-income areas range from significant barriers, like poor infrastructure, to personal issues, like how to prevent helmet hair. Other issues include a lack of bike shops and places to park bicycles (*1*). Poor design and lack of infrastructure are key issues deterring people from cycling; if more people feel a sense of safety and enjoyment, cycling will increase as a viable mode of transportation. The perceived safety of a route can impact a pedestrian's or bicyclist's comfort level and can heavily influence whether they will choose to travel in a certain location (*4*).

Arriving at work safely and looking presentable for the workday is paramount—good changing and showering facilities in or near workplaces is therefore a key consideration for commuters. Bike theft also is a common and expensive problem; safe and convenient storage at common biking destinations can strongly affect the total number of cyclists, including women (*5*).

Benefits of Bicycling and Walking

Walking and bicycling can lead to a healthy lifestyle, social connections among active transportation groups, and lower healthcare costs—outcomes that are promoted by the Federal Highway Administration (FHWA), the Centers for Disease Control and Prevention, the American Public Health Association, and other health organizations. Studies show that physical activity reduces the risk of major health concerns, including strokes, type 2 diabetes, and some forms of cancer (*6*). Practicing a healthy lifestyle also can reduce stress and depression.

To promote mobility and a healthy lifestyle, the city of Philadelphia implemented the CONNECT Transportation Business Plan three years ago to establish a presence in lower-income neighborhoods as part of a larger strategy "to tackle the city's transportation issues including bike lanes, traffic congestion, public transit, and more" (*7*). Through CONNECT, Philadelphia established the safety- and equity-focused Indego bikeshare program. Indego has built nearly one-third of its 100 stations in low-income and underserved neighborhoods of the city, making access to bikesharing possible for more people (*7*).

FHWA's Role

FHWA conducts research and provides technical assistance to state and local agencies to improve safety, mobility, livability, and equity, and to encourage innovation. The agency offers a variety of resources and technical assistance throughout the United States to help promote walking and biking among minorities and in low-income communities.

To understand some of the specific issues around safety and accessibility, FHWA led assessments to raise the profile of bike and pedestrian issues and to identify

Photo: Indego

Philadelphia's Indego bike share reaches 20 low-income neighborhoods and accepts credit cards, phone app payments, and cash.

Photo: Sean Hayford O'Leary

Sidewalks that end abruptly can be significant barriers for vulnerable users.

improvement opportunities. Common issues noted during the assessments included:

- Inadequate sidewalk width,
- Lack of sidewalks and bike facilities,
- Inconsistent surface condition,
- Inadequate markings, and
- Inappropriate crossings at midblock across multiple traffic lanes.

Unsafe locations—for example, neighborhoods with unpaved sidewalks, paths without adequate lighting, and dirt roads with no sidewalks or crosswalks—serve as barriers for all, including vulnerable populations. Safety plays an important role in a transportation network, and countermeasures to improve pedestrian and bicycle safety are outlined in resources like the FHWA's Pedestrian and Bicycle Safety Guide and Countermeasure Selection Systems.[4] Many tools also can help address personal security and devices to detect traffic violations, from improved lighting along a corridor to red-light-running cameras.

Unpaved routes pose accessibility challenges for some women in low-income communities. Discontinuous sidewalks, like the one shown above, are inconvenient and create a connectivity gap. Travel time and distance may increase as travelers seek a more acceptable route. Minority women's voices are needed to plan and prioritize safe and comfortable walking and biking networks that reflect their commuter and comfort needs, and transportation decision makers need to continue efforts to understand the challenges faced by minority women.

Minority women's voices are needed to plan and prioritize safe and comfortable walking and biking networks that reflect their commuter and comfort needs.

FHWA is committed to supporting minority women's groups in the following ways:

- Sharing effective practices and providing guidance on how present and future federal transportation funding can support safe walking and bicycling in low-income communities;
- Providing technical assistance to states through FHWA division offices; and
- Supporting transportation conferences, such as the National Bike Summit, the Safe Routes to School Conference, and Walk/Bike/Places, at which minority woman cyclists can network.

REFERENCES

1. Ober, L. How a Minority Biking Group Raises the Profile of Cycling. *National Public Radio*, July 1, 2013.
2. Department of Transportation Updated Environmental Justice Order 5610.2(a). *Federal Register*, Vol. 77, No. 91, May 10, 2012, pp. 27534–27537.
3. *The New Majority: Pedaling Towards Equity*. League of American Bicyclists, Washington, D.C., 2013, p. 9.
4. *Case Studies in Delivering Safe, Comfortable, and Connected Pedestrian and Bicycle Networks*. Federal Highway Administration, U.S. Department of Transportation, 2015.
5. What Will it Take to Close the Gender Gap in Urban Cycling? *WeLoveCycling*, April 25, 2018.
6. Gezon, L. L., E. McKendry-Smith, and A. K. Hunter. The Health Benefits of a Bicycle–Pedestrian Trail. *Parks & Recreation*, Dec. 1, 2016.
7. Sasko, C. 5 Takeaways from Philly's New Anti-Congestion, Pro-Transit Plan. *Philadelphia Magazine*, Oct. 10, 2018.

RESOURCES

Black Women Bike: DC. http://blackwomenbikedc.tumblr.com.

FHWA. Bicycle and Pedestrian Program. www.fhwa.dot.gov/environment/bicycle_pedestrian/resources.

FHWA. Pedestrian Safety Guide and Countermeasure Selection System. www.pedbikesafe.org/PEDSAFE.

Sandt, L., T. Combs, and J. Cohn. *Pursuing Equity in Pedestrian and Bicycle Planning*. FHWA, U.S. Department of Transportation, 2016, pp. 3, 11.

Transformational Technologies' Impact on Women

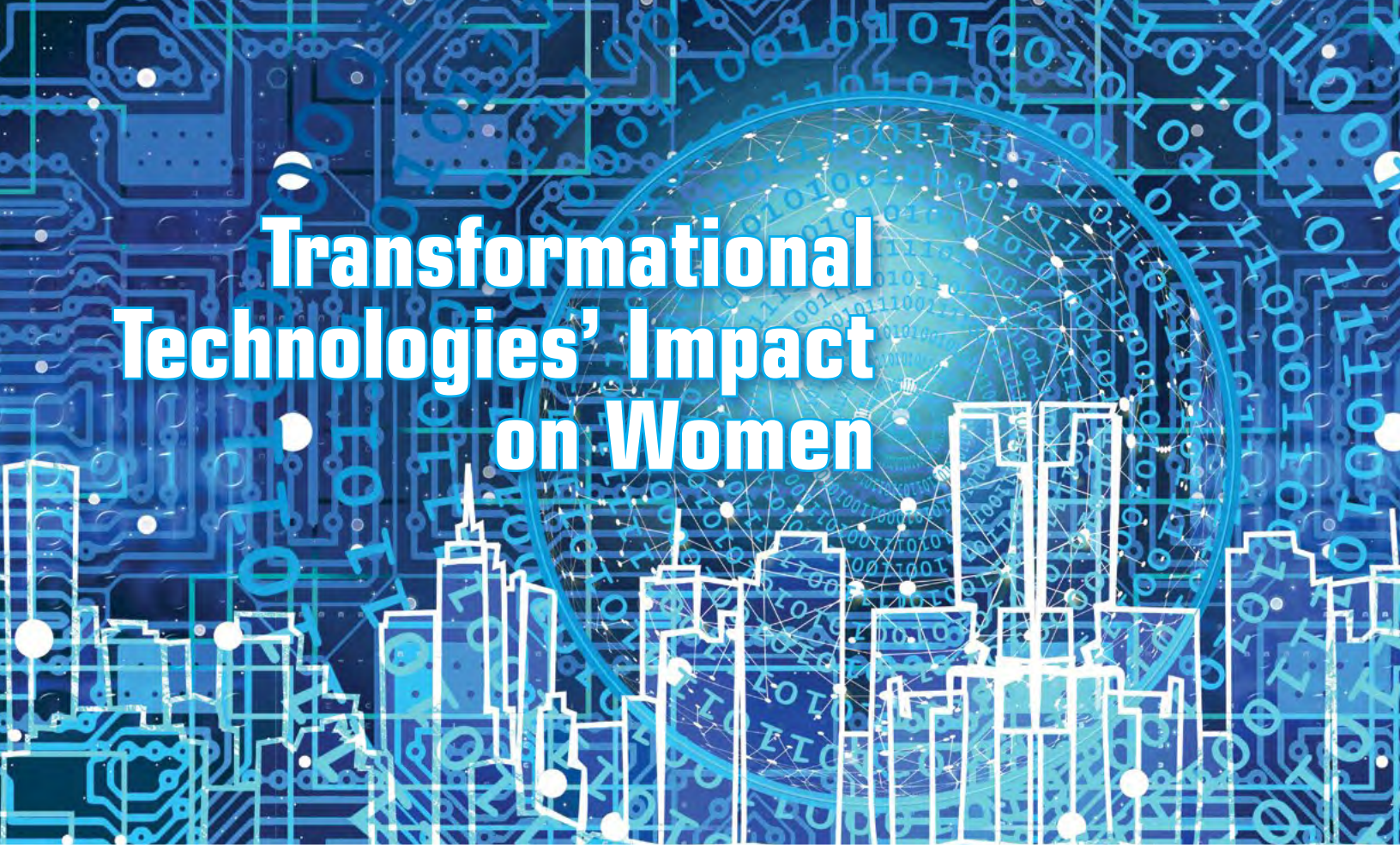

Photo: Geralt, Pixabay

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The rise of artificial neural computing about a decade ago has led to an era of very fast technological development, with neural networks able to mimic the human brain and enable a variety of artificial intelligence applications—a type of transformational technology—that can change business, communication, interactions with colleagues, shopping, transportation, and socializing.

It is extremely important to ensure that the technology-induced transformations contribute to a more equal and just society. A steered rollout of digital applications could avoid the unexpected exclusion of some societal groups, particularly elderly people, single mothers, and those without access to modern technologies.

Transformational technologies will enable a connected and automated transportation network. As connected and automated mobility becomes tangible, it is crucial to ensure that every part of society will benefit from the potential offered by these new services. Women are at risk of further disadvantages in transportation access and equity, as transportation still is a male-dominated consumer and employment industry.

Educational and Employment Needs

More women entrepreneurs should be involved in the development of innovative services, ensuring a focus on providing equally beneficial services for everyone. Although more women are studying engineering, transportation planning, and computer science, once they obtain a degree they often face a male-dominated work market in which female needs and values are not fully considered. Thus, women often find transportation a less-attractive field of employment.

Focused policy initiatives and action plans at every level of workplace responsibility, enabling organizationwide cultural change, could open technical and management opportunities for women and enhance an agency's image. Corporate

Photo: WOCinTechChat

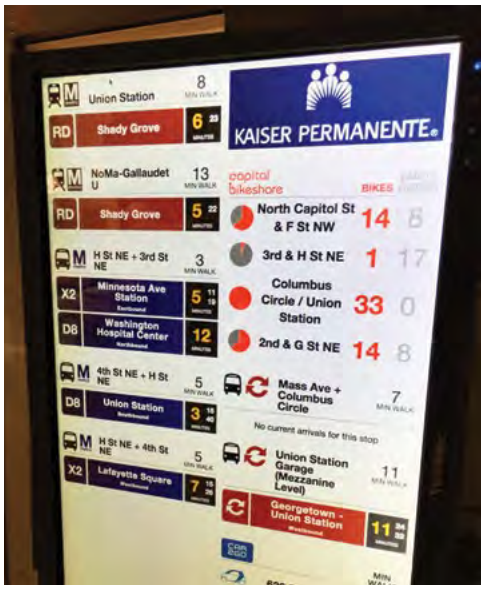

Photo: Ted Eytan, Flickr

Left: Although more and more women study engineering, transportation, and computer science, they still face a male-dominated workforce. Right: TransitScreen in Union Station, Washington, D.C. Real-time information displays can reduce wait time and increase perceived safety of transit.

and government information campaigns promoting women in the workplace or communities advancing transportation in interesting ways may incentivize even more women to earn degrees and certificates in science, technology, engineering, and mathematics programs and to enter the transportation workforce.

Women-Focused Services and Safe Access

Women could benefit from the various services provided by information and communication technologies and other innovations to adapt mobility options to their needs, but funding is inefficient for the study and development of the gender safety and economic relevance of the human–machine interface. Intelligent transportation systems (ITS) can offer more inclusive mobility options for all travelers, with women benefiting from ITS by adapting multiple mobility options to their needs. Mobility-as-a-service can facilitate daily multimodal journeys via more efficient routes and timing.

Other technologies, such as real-time information displays, mobile phones, and computer applications, are effective in reducing wait times in unsafe environments, increasing the level of perceived safety and security for female passengers. Automated transportation services may offer additional safety and security enhancements.

To optimize the positive impacts of present and future applications of innovative technologies, however, gendered analysis is recommended to assess whether specific gender needs are met properly and what the impact of these technologies on mobility behaviors would be.

For example, new shared mobility services are being implemented in more and more cities. These services pose questions about the personal safety of female passengers, faced with unregistered drivers (as with Uber and similar services) or unknown fellow passengers (as with an unmanned vehicle). These new concerns are being studied, also under a gender perspective, to contribute to dedicated regulations that would not limit the potential benefits of the services.

Developing equity measures for the triple bottom line of sustainability—environment, economics, and society—could achieve greater mobility for all, including women of all ages and abilities, whether in urban or rural areas. Greater mobility can be green mobility, too. According to the change management firm McKinsey & Company, technology advancements for integrated and greener mobility could produce benefits in urban areas, such as improved safety, greater access to high-quality jobs,

Photo: Aron Urb/EU2017EE, Flickr

An automated shuttle in Estonia. Female passenger safety in emerging transportation modes—for example, riding with strangers in unmanned vehicles—is an issue that requires consideration.

and reduced pollution (*1*). Research has shown that employment is closely related to access to safe and affordable mobility options, although access to these options varies between men and women. As a consequence, there are gender inequalities in access to transportation and multimodal trips; thus, women have limited health and employment opportunities.

Planning and Design

Women employed in transportation fields like planning and design present opportunities for dialogue around the issues women experience in transportation, facilitating the development and adoption of solutions. A typical example is the use of male-body crash test dummies for all vehicle safety standards. In 2012, Anna Carlsson, a researcher at Chalmers University of Technology in Sweden, created the first female-body crash test dummy, known as EvaRID. Carlsson found that women drivers are three times more likely than men to suffer from whiplash. Women move differently in impact situations, since car seat backs do not yield as much for women as they do for men. The use of a female-body crash test dummy is therefore critical in the development of new safety systems.

Economic Opportunity

Transformational technologies can introduce new and different job fields for women in which men do not dominate. Raising awareness of these emerging new markets of innovative and technical services jobs may attract women to these opportunities if they include other incentives, such as safe and ergonomic office environments. An awareness campaign could include more information about services for promoting customer-friendly intermodal mobility, innovations in mobility technologies, training, and education services. A new service market could offer opportunities for women with more equity. Digitalization of the transportation sector also leads to the rise of new working patterns with less income security that do not fall under the traditional schemes of social protections. These traditional systems will need to adapt to the new forms of work.

To bridge the digital gender divide, the connected woman traveler has a role to play through public investment in a capital infrastructure proposal process to ensure equal access and connectivity. Access to new forms of mobility, such as rideshare services, requires increased competence. The connected traveler has the option to integrate information about access to transportation services and personal needs for mobility, thus increasing the ability to be mobile.

For greater access to mobility options other than personal-use cars, a public-awareness campaign needs to reach all societal levels and groups to share information on all transportation options.

Accessibility to and affordability of these new forms of communication and information currently are the privilege of employed, technologically savvy, and young people. For greater access to mobility options other than personal-use cars, a public-awareness campaign needs to reach all societal levels and groups to share information on all transportation options.

Although many of the issues in gender mobility and travel patterns have been researched and studied, and it is recommended that new challenges stemming from technological development include gender assessment, the development of gender-specific policies and programs have received limited attention. Studies are needed to explore ways to translate the findings of gender research into policy. In this respect, gender impact assessments of transportation policies need to be institutionalized and carried out regularly to monitor their contribution to a gender-neutral transportation system.

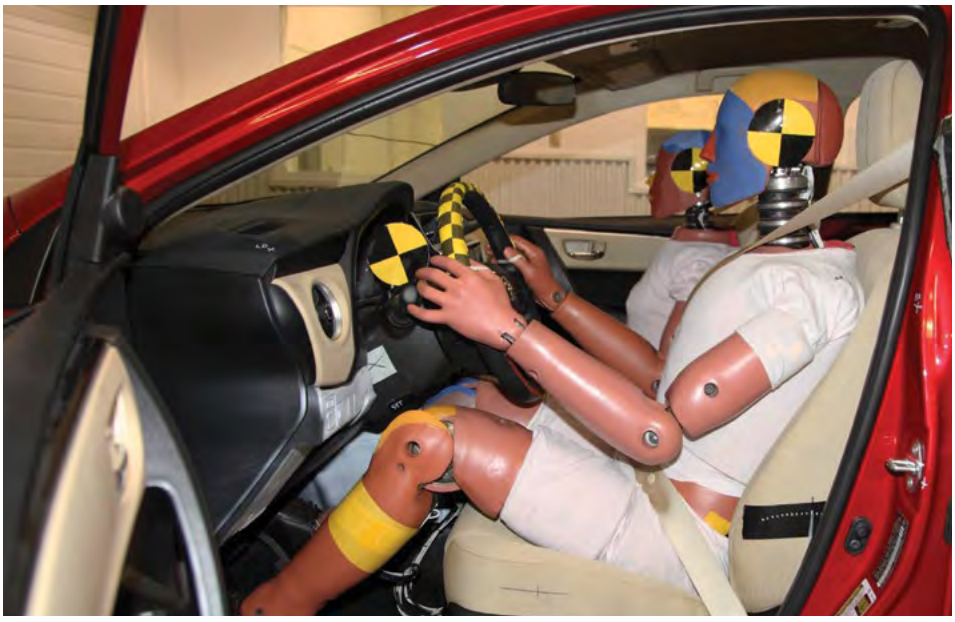

Photo: NHTSA

Male and female crash test dummies are used at a National Highway Traffic Safety Administration crash test facility. Historically, crash test dummies have been modeled after male bodies.

REFERENCE

1. Hannon, E., C. McKerracher, I. Orlandi, and S. Ramkumar. *An integrated perspective on the future of mobility.* Bloomberg New Energy Finance and McKinsey & Company, 2016.

Technology for All

How Equity, Access, and Affordability Must Feature in Next-Generation Vehicle Policy

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The development of advanced automated vehicle safety technologies, including fully self-driving cars, may prove to be the greatest personal transportation revolution since the popularization of the personal automobile nearly a century ago. (*1*)

In 2017, a bipartisan group of U.S. senators conducted a hearing titled "Paving the Way for Self-Driving Vehicles." The themes of the hearing reflect the focus of many current discussions surrounding this new group of technologies, and thus it is as reasonable a place as any from which to begin our discussion. The principles in question are specifically itemized in the hearing press release:

> Prioritize safety.... Promote innovation and reduce regulatory roadblocks.... Remain tech-neutral to avoid favoring one business model over another.... Reinforce the separate regulatory roles of federal and state governments.... Strengthen cybersecurity.... Educate the public as to the differences between conventional and autonomous vehicles. (*2*)

Although each of these principles is perfectly reasonable in itself, the list as a whole has a problematic absence: nowhere is access, affordability, or equity mentioned. With all the excitement generated by the prospect of automated vehicles saving transportation networks, very little thought has been given to the material and societal costs of that shift. How do we come to terms with current inequities and potentially use automated vehicles to build a more connected society in a way that rights those wrongs, rather than compounding them?

Machines themselves may not inherently possess the same biases and blind spots as human beings, but the designers, programmers, and industry executives steering machine algorithms and implementation certainly do. The effects of automated vehicles on the future cost of driving cannot be known, and what conjectures have been made are not necessarily reliable. As Todd Litman has pointed out:

> Most optimistic predictions are made by people with financial interests in the industry, based on experience with other disruptive technologies such as personal computers, digital cameras, and smart phones. Vehicles

typically last an order of magnitude longer, cost two orders of magnitude more, impose greater external costs, and rely more on public infrastructure than other technologies. (*3*)

Thanks to all of the factors that Litman identifies, innovations in transportation take time to play out and are affected more by local, state, and federal regulations than are many other types of technology. In the near future, automated vehicles certainly will be more costly than traditional cars because of the current high costs of necessary onboard GPS; central computers; lidar systems; and ultrasonic, odometry, and radar sensors (*4*).

Given the edifice of regulations that must be constructed and the likely financial barriers to access, urban planners must now begin the work to consider the potential effects of automated, connected, and next-generation vehicles on those who do not have the financial resources to participate in the first wave of implementation—and to plan for the biases and blind spots of the public servants and private businesspeople who will steer that implementation.

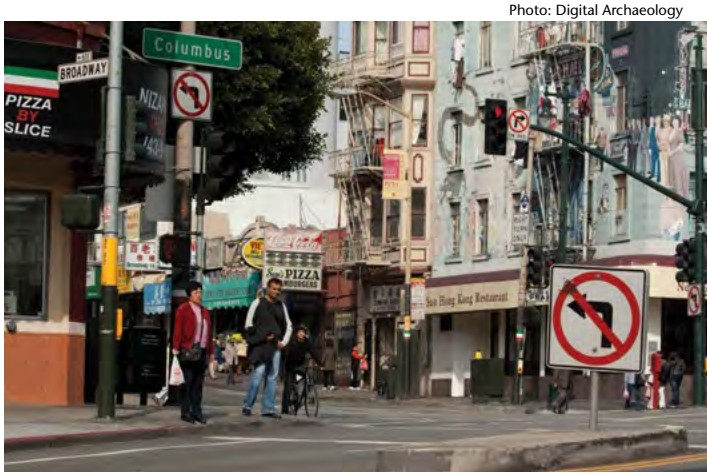
Echoes of History

TRANSPORTATION POLICY AND STRUCTURAL INEQUALITY

Going all the way back to the advent of the horseless carriage, policy discussions around the management strategies for and potential benefits of new transportation technologies have, at the local, state, and national levels, consistently neglected to consider the uneven effects of these new technologies on many underserved and underrepresented populations. Although the negative impacts of the advent of the automobile on vulnerable populations in the United States are not a frequent topic in transportation industry publications, they have been studied by anthropologists. For example, in her paper "The U.S. Car Colossus and the Production of Inequality," Catherine Lutz cites many ethnographic studies of the ways in which, for the nation's poor, "the fundamental right to mobility" has been repeatedly compromised (*5*).

Urban planners must consider the effects of connection and automation on low-income communities.

Photo: Digital Archaeology



Transportation planners tend to view a lack of access to mobility options, especially personal vehicles, as a marker of the plight of the underserved and underrepresented—but Lutz's article points to the ways in which the advent of the automobile actually helped to create much of the inequity in this country. U.S. cities and rural areas alike were built assuming car ownership as a default status for American adults. This creates fundamental barriers to employment and educational access for those without the means to own a personal vehicle.[1] As Stuart Cohen observes:

> For more than half a century our transportation system has largely focused on moving cars, in part to support increasingly sprawling land uses. Over-reliance on vehicles has come at a high expense to personal budgets, public health, and the environment. Very low-income families spend, on average, over 30% of their income on transportation. For those without a private vehicle, limited access to jobs, education, health care, and other opportunities is a barrier to self-sufficiency. (*6*)

Poorer households spend a higher percentage of their income on transportation not simply because their income is lower, but because their transportation costs often are actually higher. They often have to travel further from their homes for work and school, which is exacerbated by the fact that "about 70% of regional jobs,

[1] Not to mention medical access, access to healthy and fresh foods, and more.

Photo: Jaguar Mena, Flickr

The development of automated technology offers new opportunities for industries and communities—but access, affordability, and equity must be addressed.

For the purposes of this article, underrepresented people include women; poor communities; mobility-challenged people, including people with disabilities, seniors, and youth; and other historically disadvantaged communities, including people of color, immigrant communities (including those with language barriers), and rural communities. None of these identities occur in isolation. Many overlap, and this intersectionality must be kept in mind when discussing policies that affect underrepresented groups.

Photo: PxHere

Photo: Jasperdo, Flickr

Left: From the earliest days of modern highways—and even before—policy conversations about transportation technologies have neglected vulnerable populations and, often, have caused or exacerbated inequitable outcomes. Right: U.S. rural areas—as well as many cities—were planned and constructed under the assumption of car ownership, creating opportunity barriers to those unable to own a car.

retail, and other opportunities are now outside of downtown centers" (*7*). Public transportation networks traditionally have been built to carry riders from the suburbs to the downtown core, so those who live in one suburban area often cannot rely on public transportation to reach a job opportunity in another suburban area—even if it is nearby.[2]

On top of this, poorer households often have access to fewer functional alternatives to traditional public transportation, and their transportation costs could continue to rise as new technologies replace traditional publicly funded, publicly available transportation options.

EQUITY EFFECTS OF INNOVATION

The foundational decisions that created the above situation were made as the United States was developing its modern highway system. The equity-related effects of more recent innovations also can be considered—for example, the effects of the rise of private transportation network companies (TNCs) such as Uber and Lyft. From the local to the national level, the rise of these services has not been accompanied by a fast response from officials to create policies regulating the operation of TNCs. It has been difficult, therefore, to ensure that they are providing a genuine benefit to all communities.

According to the *Atlantic* article "Uber and Lyft Are Failing Black Riders," the same biases and bigotry that plagued the for-hire vehicle industry for decades have spilled over into the next generation of transportation options (*8–9*). Even more troubling is widespread decisions by transit agencies, private companies, and real-estate developers to use Uber, Lyft, and similar options to address first- and last-mile service gaps, rather than investing in or advocating for better transit. As more public- and private-sector decision makers explore the possibility of using TNCs to replace the connections traditionally made by public transit, underserved and underrepresented communities may feel disproportionate effects.[3]

Underrepresented people thus far have faced similar barriers to using shared modes like carpooling and ridesharing. Although tech-driven carpooling and ridesharing can potentially supplement or enhance public

[2] This scenario is particularly relevant since, according to a recent Pew report, "about half of the U.S. poor population (49%) lives in suburban and small metro counties, while 34% live in cities and 17% in rural areas." See Parker, K., J. Menasce Horowitz, A. Brown, R. Fry, D. Cohn, and R. Igielnik. *What Unites and Divides Urban, Suburban and Rural Communities.* Pew Research Center, Washington, D.C., May 2018.

[3] The transportation industry is just beginning to collect data on this topic. My own organization, 128 Business Council, began collecting data this past year on TNC usage patterns of the populations we serve.

Photo: Jim Pickerell, U.S. National Archives and Records

Residents of Atlanta, Georgia, wait for a bus. In 1974, MARTA reduced fares, increased routes, and added nightly service and parking in underserved communities—and ridership drastically increased.

transit options for some communities, "disadvantaged communities face barriers to using shared mobility including financial, technological, and language and cultural barriers. … Since many new technologies rely on scaling up the number of users in a given area, this may mean services, such as carpooling and car-sharing, are simply unavailable" (*10*).[4–5]

In many communities, transportation options beyond a privately owned vehicle are already scarce; when the focus is on the replacement of already-limited public transit options, this contributes to further segmentation of an already-segmented population. Private industry has no systematic incentive to do the right thing. Their focus usually is the bottom line; therefore, it is the role of policy makers to consider access, affordability, and equity.

If these histories and the present reality are taken seriously, it brings up the following questions: what will happen when society embraces the new frontier of automated vehicles? Will it learn from these histories—or repeat them?

Not a Neutral Streetscape

Much of the nation's transportation infrastructure lags behind current technological standards across modes—to say nothing of being prepared for new technological advancements—and this deficit especially isolates underserved and underrepresented people. Communities are not demographically integrated, and the usability and connectivity of existing roadways—the ones onto which automated vehicles would be introduced—are, on the whole, worse in those communities belonging to underrepresented groups.

When the shameful history of redlining and other barriers erected to segregate minority groups is considered, the history of road construction begins to look like a history of those with means to live in the "right" communities becoming increasingly connected to the "right" jobs and schools—to the exclusion of other communities (see box, below). One study by the Brookings Institution concluded that, although post–Civil Rights Era measures slowed and in some cases began to reverse the process of racial segregation, progress toward structural equality across communities (or toward the economic integration of those communities) in the current millennium has been underwhelming.[6] If current transportation infrastructure inequities are not addressed, how can the same segregative mistakes be avoided in the implementation of new technologies?

WHAT MACHINES MISS

Decision-making power—and even decision-making consideration—also is unevenly distributed across communities. As a result, even seemingly value-neutral differences in how transportation infrastructure has been constructed, operated, and used take on major equity-related implications. Ostensibly minor questions can be loaded: for example, how should an automated vehicle understand a pedestrian detected waving at an intersection?

Photo: Stephen Yeargin, Flickr

A 2019 Music City Riders United protest in Nashville, Tennessee, drew attention to the need to expand bus service to historically black communities.

Much of how people interact with each other in the streets is determined by a "complex and culturally guided series of interactions, including facial expressions (e.g., smiles, raised eyebrows, etc.), and gestures (e.g., a horizontal wave meaning 'go ahead' or a vertical wave meaning 'thanks')" (*11*). These expressions and gestures vary not only from region to region but even from neighborhood to neighborhood. Variations in right-of-way practices from community to community present a similar set of challenges when it comes to determining which communities' practices are taken as standard.

As defined by the Federal Reserve's Consumer Compliance Handbook, redlining is "the practice of denying a creditworthy applicant a loan for housing in a certain neighborhood even though the applicant may otherwise be eligible for the loan. The term refers to the presumed practice of mortgage lenders of drawing red lines around portions of a map to indicate areas or neighborhoods in which they do not want to make loans." For more, see www.federalreserve.gov/boarddocs/supmanual/cch/fair_lend_fhact.pdf.

[4] Physical barriers, which fall outside the scope of White's discussion, also should be mentioned here. Shared mobility options generally are unavailable to those who rely on wheelchairs—or, for that matter, strollers—and pose a special challenge to potential users with certain disabilities (*8*).

[5] "Scaling up the number of users in a given area" means that shared mobility providers are hesitant to enter areas in which there is not an established market for their services.

[6] See Frey, W. White neighborhoods get modestly more diverse, new census data show. *The Avenue*, Brookings Institution, Dec. 13, 2016. This article focuses on neighborhood demographics, not transportation issues, but the point is that transportation policy decisions that led to neighborhood segregation in the past have not been overcome in the present.

Photo: Adrian Cabrero

ECONOMIC DISRUPTION

New transportation technologies threaten to fundamentally disrupt the preexisting economic networks that use the current streetscape—especially for those who make their living operating the vehicles that transport goods and people. In the past, driving a truck or operating a train was a dependable career open to those without advanced education. Today, these employees already are struggling to afford to live in the urban centers where they primarily work. The prospect of automated technology rendering these positions unnecessary will erase entire employment sectors (*12*). What new jobs will be available to these employees?[7]

An objection might here be raised that the Federal Transit Administration does require any new transportation project receiving federal funds to conduct an equity analysis to determine any negative impact "related to race, color, or national origin" on communities (*13*). These analyses do not take into account the institutional and historical policies that created inequity, however, nor do they require any consideration of the intersectionality of identities. How can policy makers build better projects for the communities they are meant to serve when even the policies meant to protect the communities do not engage the level of complexity required to avoid marginalizing those groups further?

[7] There actually is a severe labor shortage in the trucking industry already, in part because people know that automation is on the horizon. A full discussion of labor implications, and the partially voluntary shift that may already be under way, is outside the scope of this article.

Photo: manolofranco, Pixabay

In many cities, drivers of freight, public transit, or ride-hailing services and taxis cannot afford to live where they work.

New policies for automated, connected, and next-generation vehicles cannot merely address these new technologies in isolation but also must address the shortcomings of the current transportation infrastructure and the planning that has created it. The advent of the automobile, the construction of the U.S. highway system and of legacy transit systems, and the process of segregation have combined to limit transportation access for underrepresented populations. Because this defines the status quo, without intentional action the advent of automated vehicles will only extend this inequity into the future.

Better This Time

Urban planners and policy makers alike have incredibly high hopes for the possibilities presented by automated vehicles (AVs). Brian Jencek and Jerome Unterreiner express some of these possibilities:

> The arrival of self-driving cars brings opportunities to do much more than simply compress the size of streets, tweak curb heights, and regain a few feet of sidewalk space on each side. The 4.12 million miles (6.63 million km) of roadways in the United States, some of which pass through the country's highest-value urban real estate, serve as an unparalleled land bank. As AVs leverage the 'internet of things' to connect with the surrounding infrastructure, municipalities will be able to create truly universal streets. (*14*)

As an urban planner, I welcome the opportunity to rethink how public spaces are used, but many questions remain: where will we start? Will we look at downtown corridors, new development, or redevelopments? Where will our underserved and underrepresented neighborhoods fall in this list? What will happen to these neighborhoods as the prices of homes and land increase? And, ultimately, how will we respond to all of these questions better than we have done in the past?

Meeting this challenge must begin with engagement. Underserved and

Photo: Cade Martin, Centers for Disease Control and Prevention

To help ensure equity in transportation policy, transportation leaders and policy makers must increase community engagement.

underrepresented communities historically have not had a strong voice in the planning process. The reasons for this often are incredibly simple: those most in need of more transportation options often have the least opportunity to respond to invitations for engagement.

For example, most public meetings are held in the evening, which makes attendance difficult for those without traditional 9-to-5 jobs, as well as those without easy evening availability, like single parents. The locations of these meetings also may be hard to reach. It is vital, therefore, for policy makers of all stripes to meet the communities we serve within those communities themselves, rather than expecting the public to come to us—and to put in the time to actually build a history of collaborative, two-way communication. The conversation must begin before drawing up plans and should not be merely the final stage in that plan's confirmation. Community engagement is where we must begin, not where we end.

I like the idea of automated, connected, and next-generation vehicles, but I would like them a lot more if I knew that all of us—not just those with means—will have access to the technology. I would like to know that we have a plan in place for addressing current transportation infrastructure failings. And I have to know that we are not going to continue to make the same mistakes that have led to the transportation access inequity from which communities already suffer. If we do not address these fundamental issues, the technology might not fail—but our communities absolutely will.

The views and opinions expressed in this article are those of the author and do not necessarily reflect the official policy or positions of the Massachusetts Department of Transportation of the Massachusetts Bay Transportation Authority.

REFERENCES

1. National Highway Traffic Safety Administration, U.S. Department of Transportation. Federal Automated Vehicles Policy: Accelerating the Next Revolution in Roadway Safety. Sept. 2016, p. 5. www.transportation.gov/AV/federal-automated-vehicles-policy-september-2016.
2. U.S. Senate Committee on Commerce, Science, and Transportation. "Senators Release Bipartisan Principles for Self-Driving Vehicles Legislation." Jun. 13, 2017. https://www.commerce.senate.gov/public/index.cfm/2017/6/enators-release-bipartisan-principles-for-self-driving-vehicles-legislation.
3. Litman, T. *Autonomous Vehicle Implementation Predictions: Implications for Transport Planning.* Victoria Transport Policy Institute, British Columbia, Canada, Nov. 26, 2018, p. 3.
4. Crute, J., W. Riggs, T. Chapin, and L. Stevens. *PAS Report 592: Planning for Autonomous Mobility.* American Planning Association, Chicago, Ill., Sep. 2018, pp. 15, 37.
5. Lutz., C. The U.S. Car Colossus and the Production of Inequality. *American Ethnologist*, Vol. 41, No. 2, 2014, p. 232.
6. Cohen, S., and S. Shirazi. Can We Advance Social Equity with Shared, Autonomous and Electric Vehicles? Presented at Three Revolutions: Sharing, Electrification, Automation, Davis, Calif., Feb. 2017, p. 1. www.transformca.org/sites/default/files/3R.Equity.Indesign.Final_.pdf.
7. Cohen and Shirazi, p. 3.
8. White, G. Uber and Lyft Are Failing Black Riders. *Atlantic*, Oct. 31, 2016. www.theatlantic.com/business/archive/2016/10/uber-lyft-and-the-false-promise-of-fair-rides/506000.
9. Ge, Y., C. Knittel, D. MacKenzie, and S. Zoepf. *Racial and Gender Discrimination in Transportation Network Companies*. Working Paper 22776. National Bureau of Economic Research, Oct. 2016.
10. Cohen and Shirazi, p. 4.
11. Sandt, L., and J. Owens. Discussion Guide for Automated and Connected Vehicles, Pedestrians, and Bicyclists. Pedestrian and Bicycle Information Center, Chapel Hill, N.C., Aug. 2017, p. 9.
12. *Taming the Autonomous Vehicle: A Primer for Cities*. Bloomberg Philanthropies and the Aspen Institute Center for Urban Innovation, New York, March 2017, pp. 68–69.
13. *Title VI Requirements and Guidelines for Federal Transit Administration Recipients.* Title VI Circular 4702.1B. Federal Transit Administration, Oct. 1, 2012.
14. Jencek, B., and J. Unterreiner. People-Driven Design: Planning for the Urban Future of Autonomous Vehicles. *Urban Land Magazine*, May 24, 2018.

MAINSTREAMING GENDER DATA COLLECTION

Photo: UN Women, Flickr

SHEILA MITRA-SARKAR AND FLORIDEA DI CIOMMO

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There is a growing awareness that gender-sensitive transportation data collection, although challenging, cannot be ignored by urban mobility policy makers and planners. A review of the literature confirms that sociodemographics—a critical determinant of travel behavior by gender—have been studied inadequately (*1*–*2*).

For example, a study in Amman, Jordan, investigated travel-related decisions made by private car, bus, and taxi commuters. The results indicate that morning departure time decisions are influenced by the presence of young children only for commuters who use private cars. After work, bus and taxi commuters pursue household maintenance activities and do not pursue a chain of activities; private car commuters, on the other hand, are more likely to carry out a chain of activities after work (*3*).

This study would have been even more informative to policy if gender differences in travel behavior and trip patterns had been examined. The literature review does confirm, however, that the socioeconomic

Photo: Travel and Snap, Flickr

In studies from 1988 and 2016, data show that women seek jobs closer to home because of family responsibilities and that they often choose cheaper transportation methods.

Above: In Jordan, a study shows that children are a major influence on morning commute times for travelers with private cars. Many socioeconomic factors affect women's mobility patterns across the globe.

Photo: Gaurav Ganguly

Women avoid using a bus shelter in Cairo, Egypt.

gap between men and women—leading to low employment rates, part-time jobs, and low wages—still is significant and affects women's mobility patterns (*4*–*5*).

In 1988, Wachs indicated that women are involved in complex activities because they retain their family obligations as nurturers, shoppers, and homemakers, and most often seek jobs closer to home (*6*). Ng and Acker's 2018 study in eight cities—Auckland, New Zealand; Dublin, Ireland; Hanoi, Vietnam; Helsinki, Finland; Jakarta, Indonesia; Kuala Lumpur, Malaysia; Lisbon, Portugal; and Manila, Philippines—also indicated that women still travel differently than men, using cheaper transportation alternatives and traveling shorter distances (*2*).

Research Gaps

A review of the current literature further shows 1) a scarcity of gender mobility data and statistics, 2) the need both to broaden the understanding that gender-friendly mobility services are beneficial and to develop flexible transportation alternatives, and 3) inadequate resources to study gender mobility and accessibility disparities around the world (*7*–*9*).

Transportation policies that affect both men and women require multiple data collection methods to ensure appropriate statistical analysis. Faulty methodology in data collection (e.g., incorrect sample size, sampling methods based on sociodemographic characteristics, bias in questions about travel patterns, or inadequate effort to supplement quantitative data with qualitative data) can lead to inadequate inferences about travel patterns and needs.

A 2004 study using 2001 U.S. National Household Travel Survey (NHTS) data compared the travel patterns of foreign-born adult women living in the United States with those of native-born women. The study showed that foreign-born women are less likely to drive and more likely to use public transportation than native-born women. The authors of the study admitted that the survey data were not enough to indicate why these differences exist, however (*10*).

The complexity of women's travel activities make gender a key sociodemographic determinant of daily mobility, but most transportation policies assume that women and men keep the same travel patterns and have equal access to different transportation modes (*2*). Also, these policies overlook the socioeconomic differences in travel behavior by gender, thereby inadequately serving women's travel needs.

For example, women's use of public transportation can be affected by the physical and practical considerations relating to the structural design of bus stops (see photo at top of page). Also, vehicle design may not address women's preferences or safety needs (see photo above).

Photo: Mohammed Danish Hussain

This photo, taken in Jaipur, India, shows women traveling in auto rickshaws, or modified scooters that generally carry two passengers in the rear seat. More passengers can be squeezed in to cut costs, however; in this case, a female passenger has been accommodated in the front in a manner that is culturally inappropriate.

Better Awareness for Better Data

At the 2019 TRB Annual Meeting, the Standing Committee on Women's Issues in Transportation hosted a workshop, Bridge the Gap: Eliminating Gender Bias in Transportation Research. Cosponsored with

several other standing committees, the workshop examined the data and presenters concurred that transportation needs for non-work-related trips are undervaluated in conventional assessments that focus on work commutes (*11*). Speakers and attendees suggested that gender bias occurs because researchers' stereotypes and prejudices about gender—for example, that women are caregivers rather than commuters—become implicit in the data collection methods.

For example, the photo at right depicts a woman traveling with a child strapped to her back. If researchers do not capture her traveling while caregiving, this type of mobility data would never get collected.

One possible reason why these data are not captured is that fewer women are involved in transportation decision-making, planning, and operations (*5, 12*). TRB standing committees and subcommittees plan to broaden and mobilize awareness to collect more comprehensive and useful data on women's travel patterns and caregiving trip activities. Through these collaborative efforts, gender data ideally will become richer and more useful, reflecting the multiple mobility roles assumed by women so that future transportation infrastructure and policies can be responsive to their needs.

Photo: Rohit Anand

An example of caring mobility from the Gold Coast in Elmina, Ghana. Few data are available on the number of women traveling with children strapped to their bodies.

REFERENCES

1. Maffii, S., P. Malgieri, and C. Di Bartolo. *Smart Choices for Cities: Gender Equality and Mobility—Mind the Gap!* CIVITAS, Brussels, Belgium, 2014.
2. Ng, W., and A. Acker. Understanding Urban Travel Behaviour by Gender for Efficient and Equitable Transport Policies. Discussion Paper No. 2018-01. International Transport Forum, Paris, France, 2018.
3. Hamed, M. M., and H. H. Olaywah. Travel-related decisions by bus, servis taxi, and private car commuters in the city of Amman, Jordan. *Cities*, Vol. 17, No. 1, 2000, pp. 63–71.
4. *Women's Median Earnings as a Percent of Men's Median Earnings, 1960–2017 (Full-Time, Year-Round Workers) with Projection for Pay Equity in 2059.* Report Q073. Institute for Women's Policy Research, Washington, D.C., 2018.
5. Viswanathan, K., R. Straub Anderson, and C. Pronello. Value of Travel Survey Data with Respect to Gendered Differences in Travel. Presented at 98th Annual Meeting of the Transportation Research Board, Washington D.C., 2019.
6. Wachs, M. Men, Women, and Urban Travel: The Persistence of Separate Spheres. In *Car and the City: The Automobile, The Built Environment, and Daily Urban Life* (M. Wachs and M. Crawford, eds.), University of Michigan Press, Ann Arbor, 1992, pp. 86–100.
7. Kunieda, M., and A. Gautier. Gender and Urban Transport: Smart and Affordable—Module 7a. In *Sustainable Transport: A Sourcebook for Policy-Makers in Developing Countries*. Deutsche Gesellschaft fuer Technische Zusammenarbeit, Eschborn, Germany; Bundesministerium fuer wirtschaftliche Zusammenarbeit und Entwicklung, Bonn, Germany, 2007.
8. Fernando, P., and G. Porter (eds.). *Balancing the Load: Women, Gender, and Transport.* Zed Books, London, 2002.
9. Rosenbloom, S. Understanding Women's and Men's Travel Patterns: The Research Challenge. In *Conference Proceedings 35: Research on Women's Issues in Transportation—Volume 1, Conference Overview and Plenary Papers*. Transportation Research Board of the National Academies, Washington, D.C., 2006.
10. Bose, J., and J. T. Jones. Travel Characteristics of Native- and Foreign-Born Women in the United States. In *Conference Proceedings 35: Research on Women's Issues in Transportation—Volume 2, Technical Papers*. Transportation Research Board of the National Academies, Washington, D.C., 2005.
11. Di Ciommo, F. Rethinking the Link Between Travel Behavior and Transport Planning Through the Lens of Caring Mobility. Presented at 98th Annual Meeting of the Transportation Research Board, Washington D.C., 2019.
12. Minster, C., J. Armoogum, and S. Bricka. Travel Behavior of Men and Women in France, Germany, and the United States: An International Comparison. Presented at 98th Annual Meeting of the Transportation Research Board, Washington D.C., 2019.

Current Women Leaders in Transportation

Photos: Risdon Photography

U.S. Transportation Secretary Elaine L. Chao.

TRB Executive Committee leadership: (*left to right*) 2019 vice chair Leslie Richards, 2019 chair Vicki Arroyo, and 2018 chair Katie Turnbull.

In 2019, women fill an unprecedented number of leadership roles throughout the transportation industry. U.S. Transportation Secretary Elaine L. Chao may be the highest-profile of these, but other women also are at the helm of transportation and engineering organizations.

For the first time in history, the TRB Executive Committee chair and vice chair—as well as the immediate past chair—are all women. Katie Turnbull, Executive Associate Director of the Texas A&M Transportation Institute, chaired the group in 2018; this year's chair is Vicki Arroyo, Executive Director of the Georgetown Climate Center; and the current vice chair—and 2020 chair—is Leslie Richards, Secretary, Pennsylvania Department of Transportation (DOT).

Although the American Society of Civil Engineers (ASCE) encompasses other branches of engineering along with transportation, its current leadership also is female. The 2018 ASCE president was transportation engineer Kristina Swallow; she since has been appointed Director of Nevada DOT. Robin Kemper, a senior risk engineering consultant with a background in structural engineering, is the 2019 ASCE president.

Along with Richards and Swallow, in 2019 a record-setting total of 13 women led or lead state DOTs. Many of these women are newly appointed, chosen by the governors elected in November 2018:

- Laurie Berman led California DOT, or Caltrans, from 2018 to 2019. She rose up through the organization after starting there in 1983.
- Shoshana Lew became Executive Director of Colorado DOT in early 2019, after a career that included U.S. DOT and Rhode Island DOT.
- Appointed Delaware Transportation Secretary in 2015 from the Delaware Division of Motor Vehicles, Jennifer Cohan is one of the longer-serving female DOT leaders.
- In early 2019, Julie Lorenz was appointed Kansas Transportation Secretary; before that she was a senior consultant at the firm Burns & McDonnell.
- Stephanie Pollack has served as the Secretary of Transportation and CEO of Massachusetts DOT since 2015. She came to the role from an academic position at Northeastern University.
- Margaret Anderson Kelliher was named Minnesota DOT Commissioner at the end of 2018; she had served as a politician in the Minnesota House of Representatives.
- Melinda McGrath became Executive Director of Mississippi DOT in 2012, and has served a long tenure, regardless of gender, by state DOT standards. She had previously served as the agency's chief engineer.
- Victoria Sheehan was sworn in as New Hampshire DOT Commissioner in 2015, coming to the role from the Massachusetts DOT.
- Diane Gutierrez-Scaccetti became New Jersey DOT Commissioner in 2018, having most recently served as Executive Director and CEO of Florida's Turnpike Enterprise.
- Christy Hall was appointed South Carolina Transportation Secretary in 2015; she previously was the agency's Deputy Secretary for Engineering.
- After a career in politics, Shannon Valentine became Virginia Transportation Secretary in 2018.

Certainly, these are not the only women in leadership roles throughout the transportation industry, and the gender imbalance has improved significantly over recent decades. Although gender parity is still a ways off, it is worth highlighting these and other women who are bringing the industry into the future.

—Katherine Kortum, Senior Program Officer, Consensus and Advisory Studies, Transportation Research Board, Washington, D.C.

Did You Know?

Women Transportation Pioneers

1888: Bertha Benz
The first person to drive an automobile long-distance, generating significant publicity and marketing for the Benz motorcar, Bertha Benz took her two sons on a 66-mi journey from Mannheim to visit her mother in Pforzheim, Germany. Her experience led to significant revisions to the Benz patent. The wife of Karl, Benz was essential to the successful launch of the Benz Motor Company.

1900: Anne Rainsford French
The first American woman to receive an official driver's license, Anne Rainsford French was issued a Washington, D.C., license on March 22, 1900.

1903: Mary Anderson
Mary Anderson patented the first windshield-wiper system in 1903. The device consisted of a rubber blade, held by an arm and a spring and operated manually via crank from the inside of the vehicle cabin. Anderson's patent expired after 17 years, without having earned her a living. The windshield wiper became standard in the auto industry only after her patent expired.

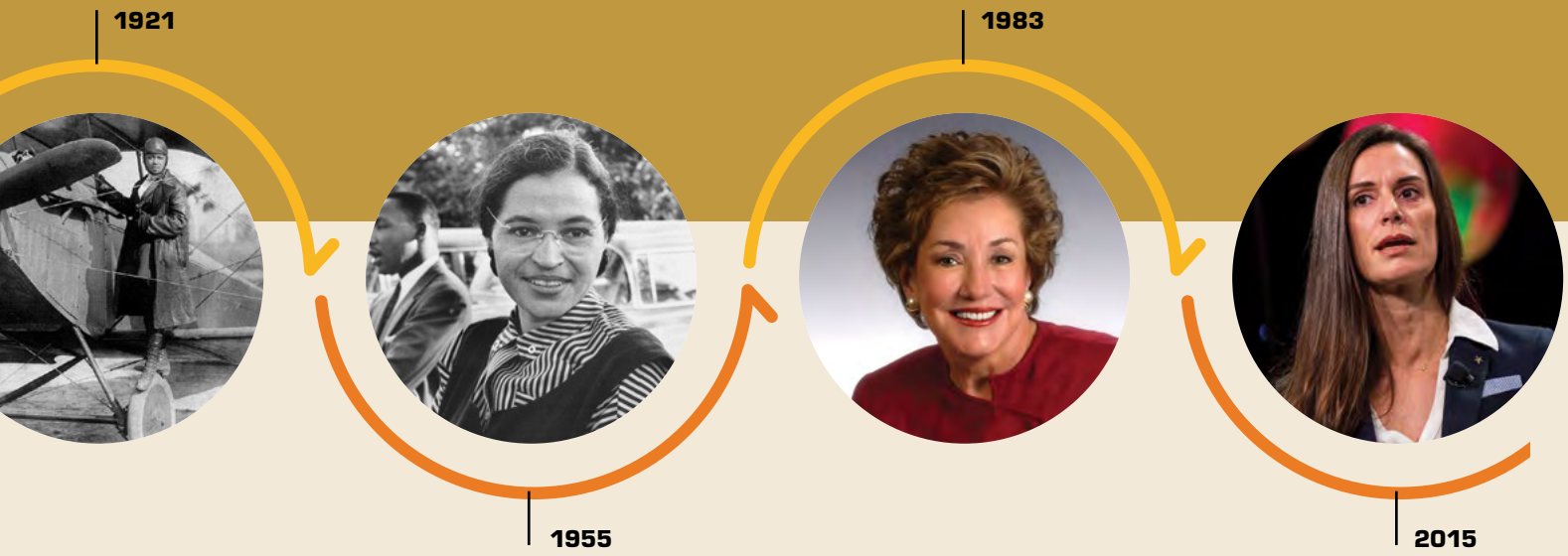
1914: Florence Lawrence
Florence Lawrence is credited with inventing the first auto-signaling arm, a predecessor to the modern-day turn signal. She devised a mechanism that raised and lowered a flag on the rear bumper of the car at the push of a button. Lawrence also developed a "Full Stop" sign that rose when the driver pressed the foot brake—the predecessor to brake lights. An actor who appeared in more than 300 movies, Lawrence earned enough money to be one of the first people to buy her own car. She soon started coming up with ideas to improve it.

1920s: Dorothée Pullinger
One of the first female car designers, Dorothée Pullinger also was one of the first to put an emphasis on women's needs. She applied to join the Institution of Automobile Engineers but was declined on the grounds that "the word person means a man and not a woman." Pullinger oversaw more than 7,000 female munitions workers at the Barrow-in-Furness plant in Cumbria during World War I. As manager of Galloway Motors, she introduced the Galloway 10/20, a lighter and more compact car than others available at the time—and instantly appealing to women.

1921: Bessie Coleman
The first woman of both African-American and Native American descent to hold an aviation pilot's license, Bessie Coleman received her license in France after U.S. authorities refused to issue her one because of her gender, ethnicity, and race.

1983: Elizabeth H. Dole
Elizabeth Dole was the first female U.S. Transportation Secretary. Her priority was increased safety. She promoted such measures as a third rear brake light and airbags in all vehicles and helped raise the drinking age to 21 years.

2015: Kate McCue
Kate McCue was the first American woman to act as commanding officer of a mega–cruise ship. Today, women represent only 2% of the world's 1.2 million seafarers; 94% of female seafarers work in the cruise industry.



1943: Helene Rother
A German-born World War II refugee who previously had designed jewelry and hat pins for high-class Parisian society, Helene Rother quickly became Detroit's first female interior car designer. She worked on General Motors' interior styling staff.

1955: Rosa Parks
As Rosa Parks commuted home from her job as a seamstress in Montgomery, Alabama, she refused to give up her seat to white passengers as requested by the bus driver. This sparked the Montgomery County Bus Boycott, led by Dr. Martin Luther King; Parks became an icon of resistance and an important symbol of the modern Civil Rights Movement.

1977: Janet Guthrie
Janet Guthrie qualified for and competed in the Indianapolis 500 in May 1977. Before becoming a race car driver, she worked as a pilot, flight instructor, aerospace engineer, technical editor, and public representative for major corporations.

1983: Carmen E. Turner
Carmen E. Turner served as general manager of the Washington Metropolitan Area Transit Authority from 1983 to 1990. She was the first African-American woman to lead a major transit agency. During her tenure, Metrorail expanded 40% and annual ridership hit 70 million passengers.

—Winnie Okello, Senior Civil Engineer, Transportation, Pennsylvania Department of Transportation, Harrisburg

WEB RESOURCES

www.history.com/topics/black-history/underground-railroad

https://autowise.com/10-historical-auto-industry-females/

www.pbs.org/wgbh/aia/part4/4p2944.html

www.historicvehicle.org/florence-lawrence-automotive-inventor-worlds-first-movie-star/

www.historicvehicle.org/godmother-automotive-design-helene-rother/

https://timeline.com/bessie-coleman-first-black-female-pilot-4eb9102e202c

https://blog.ggbailey.com/6-women-inventors-pioneers-of-the-automotive-industry

https://history.house.gov/People/detail/12577

www.forbes.com/sites/break-the-future/2016/12/27/advice-from-the-first-woman-mega-cruise-ship-captain-surround-yourself-with-diversity/#44c15d5521bb

www.imo.org/en/OurWork/TechnicalCooperation/Pages/WomenInMaritime.aspx

https://on-trac.co.uk/the-history-of-women-in-rail/

www.transportation.gov/womenandgirls/timeline/accessible

Photo: Adam Moss, Wikimedia

TRAGEDY IN SCHOHARIE, NEW YORK, and Stretch Limousine Regulatory Reform

MATTHEW W. DAUS

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Above: The intersection in Schoharie, New York, where a limousine crashed, killing 20. The incident has renewed the need to revisit safety requirements for stretch limos, especially those modified after assembly.

A tragic limousine crash took the lives of 20 people in Schoharie, New York, in 2018. As the small town mourns the loss of life from one of the deadliest transportation disasters in almost a decade, policy makers across the United States may be reexamining the regulations surrounding stretch limousines to ensure more uniform and heightened safety laws and protocols are in place. This article will explore the implications of this high-profile crash; the response of legislators, investigators, and policy makers; and what may happen next. Also explored are past and present stretch limo industry trends and safety protocols, as well as the federal, state, and local regulatory framework.

What Is Known

It is not yet known what caused or contributed to the Schoharie crash, though the circumstances surrounding the incident are highly unusual. How does a limousine crash, in a quiet part of town—leaving no skid marks on the road—lead to the death of 17 passengers, the driver, and two pedestrians?

In the early afternoon of October 6, 2018, a 2001 Ford Excursion that had been stretched to seat 18 people crashed at the junction of SR-30 and SR-30a in upstate New York. The intersection—situated at the bottom of a hill on a long and winding two-lane rural road—was notoriously dangerous. For reasons that are not yet known, the vehicle blew through the intersection without stopping and into a parking lot, where it struck a parked vehicle and two pedestrians before careening into a gully. Autopsy results confirmed that all 20 victims died from the impact of the accident, with "multiple severe traumatic blunt force injuries" (*1*).

The 17 passengers—including four sisters, two brothers, and their friends—were celebrating a birthday, taking a midday wine and beer tasting excursion. The limousine had been the second choice for the group; the bus they intended to reserve broke down on the day of the celebration. On the surface, the details of

the limousine crash show that there were many factors for alarm: the driver did not hold the required commercial driver's license to operate the vehicle; the limousine itself had failed its vehicle inspection and was tagged with a collection of violations that deemed it unsafe to drive; and the inspection report of September 28, 2018, states that the brakes were out of service.

Two days before the crash, the owner of the limousine tried to sell the vehicle for $9,000 in an ad posted on Craigslist. Contradicting the inspection report, the ad states that the vehicle had accrued 180,000 miles, could carry 18 passengers, and was "DOT Ready" and "full[y] serviced" (*2*).

Response of Regulators

The National Transportation Safety Board (NTSB) is investigating the crash, and federal and state legislators and government transportation officials already have proposed legislation and have called for investigations and regulatory changes to improve the safety of stretch limousines. Local prosecutors have granted federal safety investigators only limited access to the vehicle involved in the crash because of the ongoing criminal investigation against the limo company's operator, Nauman Hussain (*3*). The vehicle has been in the possession of the New York State Police since Hussain was charged with criminally negligent homicide, and it is not known when NTSB will be allowed to examine the limo fully.

On February 11, 2019, without having had any access to the vehicle, NTSB issued a preliminary report of its investigation, which presented no new information beyond what had already been reported. According to the preliminary report, all aspects of the crash remain under investigation "as the NTSB focuses on determining the probable cause, with the intent of issuing safety recommendations to prevent similar crashes."

It has been widely reported that the vehicle should not have been on the road after it failed inspection and that state inspectors had placed a sticker on the vehicle the month before the crash, declaring

Photo: Ken Ford, Flickr

An 18-passenger stretch Ford Excursion, similar to the one that crashed in Schoharie.

it "unserviceable" (*4*). In April 2019, it was reported that the driver had a "significant" amount of marijuana in his system at the time of the accident (*5*).

What Limo Crash Statistics Show

Although the magnitude of the Schoharie limousine crash caused intense media attention, available statistics reveal that the number of motor vehicle fatalities declined slightly from 2016 to 2017 (Figure 1, below)—from 37,806 to 37,133, or 1.78% (*6*). Limousine crashes accounted for only one out of 34,439 police-reported fatal crashes in 2016, the most recent year for which National Highway Traffic Safety Administration (NHTSA) data are available. NHTSA data also show only 12 crashes involving large limos from 2012 to 2016, with a total of 12 fatalities (*7*).

Based on New York City data tracked by the city's Taxi and Limousine Commission (NYC TLC), limousine crashes declined between July 2014 and September 2018 (Figure 2, above). None of these

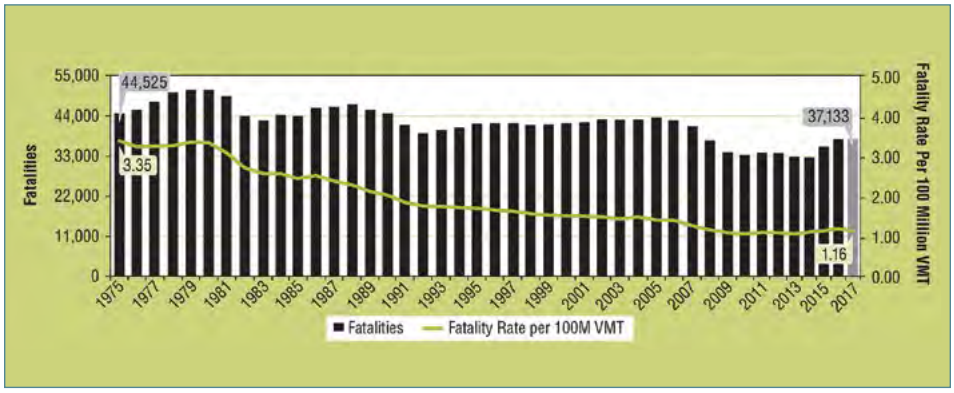

FIGURE 1 Fatalities and fatality rate per 100 million vehicle miles traveled (VMT) by year, 1975–2017. (Source: Federal Highway Administration.)

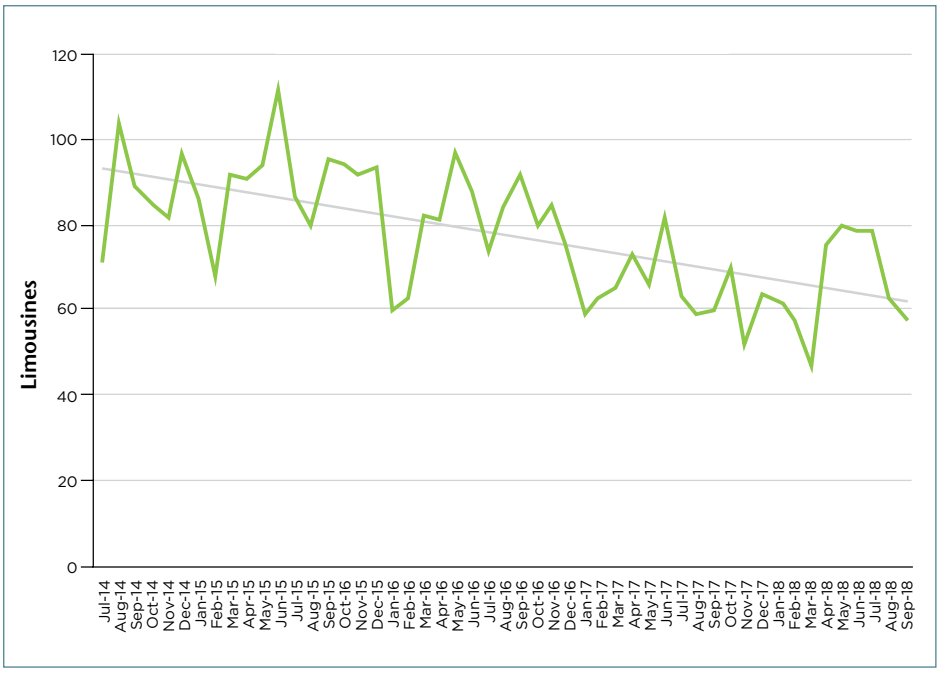

FIGURE 2 Luxury limousines involved in a crash, 2014–2018. (Source: NYC TLC.)

cases involved critical injuries or fatalities. Because of the large size of limousines, however, when high-impact crashes do occur—even if crashes themselves are not frequent—the risk of serious bodily injury or death is elevated, as with buses and trains.

Not the First Tragic Limo Crash

The birthday celebration-turned-tragedy in October 2018 featured many of the issues in the stretch limousine industry that have not been addressed since previous crashes. On July 18, 2015, 3 years before the Schoharie crash, a similar incident near Long Island, New York, prompted the Suffolk County Supreme Court Special Grand Jury to investigate the facts and circumstances of the crash, in which the front of a pickup truck drove into the side of a limousine. From this investigation, the grand jury issued a 159-page report that provided a list of legislative, executive, and administrative recommendations intended to prevent similar crashes in the future (*8*).

The report recommended legislative changes, including prohibiting limousines from making U-turns; requiring that limo passengers wear seat belts; classifying stretch limousines that seat nine or more passengers under the definition of "bus"; requiring that limo drivers have a commercial driver's license (CDL), which would include drug testing; and increasing the penalties for professional drivers who cause fatalities while driving for hire. The report also recommended creating a task force with limousine industry officials to "study the safety of stretch limousines."

Most of the recommendations were not implemented at the time; however, New York State lawmakers passed many of the recommended measures in April 2019 as part of the state budget process—including the ban on U-turns, tougher inspection laws, increased fines, reclassifying certain offenses as felonies, and higher insurance rates for higher-seating-capacity limousines. Following the passage of those laws, the New York State Senate Committee on Transportation held a hearing on limo and bus safety, at which the family members of many limo crash victims testified about the need to adopt additional legislation, such as requiring seat belts in limos and that limo drivers have a CDL license.

In another crash, which took place in Cranbury, New Jersey, in June 2014, a semi truck driver collided with a 2012 Mercedes-Benz Sprinter limo van, killing one passenger, severely injuring four passengers, and leaving five passengers with minor injuries. According to an NTSB report, no passengers in the limo van had been wearing their seatbelts when the crash occurred, even though limo van occupants are required by New Jersey and Delaware law to wear seatbelts (*9*). The report also found that the limo van operator, Atlantic Transportation Services, did not inform the passengers that they were required to wear seatbelts, nor were there any placards in the vehicle prompting passengers to wear seatbelts (*9*).

Photo: Larry Lamsa, Flickr

Many limousine deaths occur because passengers do not wear seatbelts, despite laws requiring their use.

In San Mateo, California, a limousine caught fire on May 4, 2013, killing five of the vehicle's nine passengers. The converted 1999 Lincoln Town Car limousine had been carrying two people in excess of its seven-passenger capacity (*10*). The rear doors of the vehicle were compromised in the fire, making the only available exit from the vehicle the small pass-through partition into the driver's compartment. This limousine crash prompted California to amend a section of its motor vehicle code to require modified limousines to be equipped with at least two rear side doors and one or two rear windows that may be used by rear-seat passengers or all passengers for immediate exit in case of a fire or other emergency (*11*). Among other things, the amendment requires owners or operators of a limousine to inform all passengers of safety features at the beginning of any trip, as well as to disclose to the contracting party and passengers whether the limousine meets safety requirements (*11*).

Evolution of the Regulatory Landscape

In the 1980s and 1990s, unregulated coachbuilders modified vehicles aftermarket to create stretch limousines that included hot tubs, beds, or private rooms—even an articulated limo that bent when turning corners. Bigger was better in the eyes of passengers and limo companies alike.

One of the key safety issues involved in stretch limousines is the structural integrity of the vehicle when, after the vehicle is manufactured, coachbuilders cut the chassis and extend the car's length. In April 1987 in Long Island, New York, a groom and best man were killed when the limousine they were taking from the wedding to the reception was hit crossing an intersection and split in half.

Although the trend of creating super-stretch limousines may be fading, many older vehicles remain on the road. Also, a new trend of excess has emerged with aftermarket modifications to party buses—dance floors and poles, stairs to access the roof, and other modifications—that may not involve the structural integrity of the vehicle but that raise other safety concerns.

Photo: PxHere

California now requires limousines to have rear side doors and windows for emergency exits.

One of the key safety issues involved in stretch limousines is the structural integrity of the vehicle when coachbuilders cut the chassis and extend the car's length.

CERTIFICATION PROGRAMS

Unlike in most areas of the country, anyone who wants to operate a stretch limousine in New Jersey and New York City must prove that the vehicle was modified by a manufacturer-certified stretch limousine builder. After national media coverage of fatal limo crashes, limousine fires, and tire blowouts in the late 1980s, NHTSA pushed Ford, General Motors (GM), and the limousine industry to develop a testing and certification program to ensure compliance with federal safety standards. As a result, Ford formed a vehicle certification program called Quality Vehicle Modifier (QVM) in 1990, and GM created its own Fleet Cadillac Master Coachbuilders (CMC) program in 1992. Through these programs, Ford and GM distributed information explaining how to convert certain vehicles into limousines that met federal motor vehicle safety standards. The manufacturers also certified coachbuilders to perform aftermarket modifications on certain vehicles in accordance with automotive engineering standards. QVM and CMC coachbuilders are required to adhere to specific engineering and quality-control guidelines, which are designed with the vehicle's capabilities in mind. An attempt by a specialty limousine builder in Missouri to challenge the QVM and CMC programs as anticompetitive ultimately was unsuccessful.

The QVM and CMC programs limit conversions to specific vehicles that are specifically engineered, designed, and built for heavy-duty application and coachbuilder conversion; for example, current QVM rules state that only the Lincoln MKT Town Car model is approved for conversion into a stretch limousine,

and that these vehicles may be stretched a maximum of 120 inches. The CMC program is limited to modifications of the Cadillac XTS Professional Vehicle chassis. These programs provide manufacturer approval, oversight, an extended limited warranty on major components, and—most importantly—safety. They are not, however, mandatory for licensing outside of New York City.

DIFFERING JURISDICTIONS

Commercial vehicles that are used to transport passengers could come within the jurisdiction of federal, state, or local regulators, depending on vehicle size, seating capacity, and whether passengers are being transported across state lines. Governance is disjointed and regulation inconsistent among states and localities with differing standards, especially regarding stretched vehicles.

Since the plethora of government agencies base their differing definitions and jurisdiction on seating capacity, one of the threshold questions is whether a stretch limousine is to be treated as a bus or a for-hire vehicle. In New York, the grey areas and loopholes in state law make it possible to evade New York City's jurisdiction by designing the vehicles to carry 10 or more people, including the driver, and registering the vehicles as buses with the New York State Department of Transportation (DOT), which inspects these vehicles.

Governance is disjointed and regulation inconsistent among states and localities with differing standards, especially regarding stretched vehicles.

What Happens Next?

In the aftermath of the Schoharie crash, legislators and government transportation officials may closely examine their own laws and transportation policies regulating the stretch limousine and party bus industries. There are many directions new regulations could take. For instance, legislators could pass a mandatory vehicle retirement age for stretch limousines that are not part of a manufacturer's program. NYC TLC is the only agency in the United States that has implemented regulations for taxicabs to be retired and replaced by new vehicles 7 years after a vehicle has been placed into service, ensuring that the cabs meet the latest NHTSA standards (*12*).

Another direction regulators could take is to subject older stretch limousines and vehicles with higher mileage to more frequent, rigorous safety inspections. Any stretch limousine that was not modified by a manufacturer-certified stretch limousine builder could be subjected to heightened inspections and required to be equipped

Photo: PxHere

New York City mandates drug testing, probationary licensing, defensive driving courses, and ease of driver removal for traffic violations for limousine companies.

with crash-avoidance technology, telematics devices that record driver behavior, and vehicle diagnostics.

In terms of limousine vetting, New York City implemented reforms for all TLC-licensed drivers in 1998, requiring mandatory drug testing, probationary licensing, mandatory defensive driving courses, and lowest-point thresholds for removing drivers from the road for traffic convictions (*12*). State and local regulators may explore adoption of similar standards for drivers in their jurisdictions (*13*).

On the federal level, the Federal Motor Carrier Safety Administration (FMCSA), which regulates interstate buses and trucks, also regulates limousines with a seating capacity of more than 11 passengers. FMCSA has rigorous rules to ensure that drivers receive medical certifications and now uses technology to ensure that drivers cannot work longer than a certain number of consecutive hours.[1]

Federal Motor Carrier Safety Regulations (FMCSRs) require companies that operate commercial motor vehicles (CMVs) and vehicles for hire with a designed seating capacity of more than eight, including the driver, to register with the FMCSA and undergo a safety inspection if operated interstate. Many states, including New York, New Jersey, and Connecticut, require all CMV carriers to register with FMCSA and obtain a U.S. DOT number, even if the carrier does not cross state lines.[2]

FMCSA, part of U.S. DOT, tracks and regularly audits CMV operations to ensure they comply with FMCSRs. These regulations include driver qualification, vehicle inspection and maintenance requirements, and driver hours of service. Under FMCSRs, every CMV must be inspected every 12 months by a qualified inspector who has training or certification to examine and maintain CMVs—which could be the motor carriers themselves (*14*). Motor carriers are banned from using a CMV unless each component identified in an appendix to FMCSA regulations has passed an inspection at least once during the preceding 12 months (*15*).

Regulatory reform could be a call to action to immediately identify and implement uniform best safety practices for limousine vehicles and drivers.

Regulatory reform could be a call to action for legislators, transportation officials, and vehicle manufacturers everywhere to immediately identify and implement uniform best safety practices for limousine vehicles and drivers. Any such regulation should be reasonable and effective, leveraging technology and providing for safety and accountability at every level. Even if the cause of the crash may not result from faults or shortcomings in government regulation, government typically reacts to high-profile crashes and takes a fresh look at issues and laws. In memory of the victims of the Schoharie crash, manufacturers and regulators should do everything they can to prevent future tragedies, and identify shortcomings or gaps as a result of the attention this crash has received.

[1] The FMCSA Electronic Logging Device (ELD) Rule, which went into effect in December 2017, requires motor carriers to install and use ELDs for more accurate hours of service recording. The devices, which range from $200 to $800 each, replace paper logs and make it easier to track, manage, and share records of duty status (RODs) data. Connected to the vehicle's engine, the ELD records all activities when the vehicle is in use—not just drive time—and allows drivers to manually log when they are off duty or in the sleeper berth.

[2] The ELD rule has four key components: 1) mandating that commercial drivers who are required to prepare hours of service and RODS must use an ELD, unless they are exempt; 2) setting ELD performance and data standards and requiring FMCSA self-certification of all ELDs; 3) identifying categories of supporting documents that drivers and carriers are required to keep; and 4) prohibiting harassing drivers based on ELD data and providing recourse for drivers who believe they have been harassed.

REFERENCES

1. Cause of Death Released for 20 Victims in NY Limo Crash. *Associated Press*. Oct. 19, 2018.
2. Hughes, S. Prestige Limo tried to sell vehicle days before fatal crash. *Albany Times Union*. Oct. 10, 2018.
3. Report: NTSB Not Yet Allowed to Inspect Limo in Deadly Upstate Crash. *CBS Local New York*. Oct. 18, 2018.
4. Hill, M., and J. Paltz. Operator of Limo Company in Deadly Crash Charged by New York State Police. *Time Magazine*. Oct. 10, 2018.
5. Lyons, B. Driver in limousine crash had marijuana in system. *Albany Times Union*. Apr. 3, 2019.
6. *2017 Fatal Motor Vehicle Crashes: Overview*. Report DOT-HS-812-603. National Highway Traffic Safety Administration, U.S. Department of Transportation, 2017.
7. Intersection where limo crash killed 20 is a menace, says store manager. *Associated Press*. Oct. 8., 2018.
8. 10F New York Supreme Court Suffolk County Special Grand Jury, *Grand Jury Report* § CPL 190.85 (1)(C), 2016.
9. *Multivehicle Work Zone Crash on Interstate 95, Cranbury, New Jersey, June 7, 2014*. Accident Report NTSB/HAR-15/02, PB2015-105186. National Transportation Safety Board, 2015.
10. Gray, M. Fatal bachelorette limo fire over San Francisco Bay ruled an accident. *CNN*. Aug. 19, 2013.
11. Calif. Assembly Bill No. 863, Chapter 480, § 27375, 2015.
12. Scheduled Vehicle Retirement, Title 35 Rules of the City of New York (RCNY) § 67-18, 2018.
13. Drivers of Taxicabs, For-Hire Vehicles and Street Hail Liveries, 35 RCNY § 80, 2016.
14. Periodic Inspection. 49 C.F.R. § 396.17, 2018.
15. Minimum Periodic Inspection Standards. 49 C.F.R. § III-B Appendix G, 2016.

Response to a Rapidly Transforming Field

The Transportation and Air Quality Committee's Strategic Plan

Photo: V.T. Polywoda Anyang, Flickr

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Above: Rapid motorization has created severe air quality issues in countries like China. TRB's Transportation and Air Quality Committee is responding to these transformations.

The field of transportation air quality is undergoing rapid transformation: from a vehicle perspective, electrification, sharing, and automated vehicles promise swift change in mobility; from an air quality perspective, new, low-cost technologies revolutionize public access of real-time and localized air quality conditions. At the same time, fleet turnover continually reduces per-vehicle emissions and many large metropolitan areas have experienced substantially improved air quality, particularly in the United States and other Western countries.

Greenhouse gas emissions remain well above the levels required to meet the international goals for limiting global warming outlined in the Paris Climate Agreement of 2016, however. Rapid motorization has led to severe air quality problems in developing countries like India and China, and recognition is growing of the health risks of certain pollutants like ultrafine particles.

Meanwhile, disruptive mobility technologies, including electrification, sharing, and automated vehicles, are changing travel. Lower-cost monitoring technologies and improved computational methods such as network and cloud-based computing now allow fine-resolution linked travel, emissions, and dispersion modeling with reasonable run times.

The TRB Standing Committee on Transportation and Air Quality spent much of 2018 considering these transformations and weighing their effect on the information needs of transportation and air quality planning agencies, as well as those of other stakeholders interested in reducing transportation-related air pollution.[1] This article offers a look at the committee's recent efforts and its work planned for the next 3 to 5 years.

[1] For more information on the Standing Committee on Transportation and Air Quality (ADC20) and its work, visit www.trbairquality.org.

Standing Committee Evaluation

TRB hosts more than 200 standing committees. These volunteer committees allow for transportation professionals and students to network with others in the field and stay current on emerging issues, contributing to the continuing evolution of transportation research and practice. Some of the most important activities of TRB committees include:

- Reviewing papers submitted for presentation at the TRB Annual Meeting or publication in the *Transportation Research Record: Journal of the Transportation Research Board;*
- Organizing technical workshops and sessions at the Annual Meeting and at midyear committee meetings; and
- Developing and prioritizing research needs statements and submitting them for funding from TRB Cooperative Research Programs and other sources.

Every 3 years, each standing committee conducts a critical reevaluation of itself, documenting the results in a triennial strategic plan (TSP). The plans' content and process for developing them vary by committee, committee members, and even update cycle. Some updates are routine; others involve a comprehensive look at a committee's mission, membership, and activities.

In 2018, the Transportation and Air Quality Committee conducted a comprehensive self-assessment in preparation for its 2019 TSP update. The committee identifies, stimulates, and disseminates important research related to transportation and air quality, with a scope that covers the full range of relationships between transportation and air quality: regulatory and policy considerations, modeling practices, health effects, new technologies, and transportation management strategies.

The Transportation and Air Quality Committee's latest strategic planning work responds to the rapid transformations taking place in transportation air quality. This article is organized into three sections: 1) a discussion of the strategic planning process; 2) findings from the process, including an action plan for committee activities and priorities; and 3) thoughts on the applicability of the process to other TRB committees.

SWOT analysis breakout group of nongovernmental organizations at the TRB Annual Meeting in January 2018.

Strategic Planning Process

JANUARY 2018

The Transportation and Air Quality Committee began the strategic planning process by conducting a strengths, weaknesses, opportunities, and threats (SWOT) analysis at its regularly scheduled meeting in January 2018, which took place at the TRB 97th Annual Meeting in Washington, D.C. The purpose of the SWOT analysis was to better understand what committee members, friends, and other attendees thought about best committee practices and areas in which meaningful changes could be found.

The meeting divided into three breakout groups; each group represented a different constituency within the transportation air quality community. Participants in one group were predominantly from environmental agencies; a second group was composed of representatives largely from transportation agencies; the final group included representatives from nongovernmental organizations. Each group was assigned a leader, a note taker, and a flip chart, and was asked to think about the Transportation and Air Quality Committee through a SWOT lens:

- **Strengths**. What does the Transportation and Air Quality Committee do really well?
- **Weaknesses**. In what ways can the committee improve?
- **Opportunities**. In what areas should the committee lead on topics, partnerships, and more?
- **Threats**. What can reduce the committee's effectiveness, and what should the response be?

A breakout group representing environmental agencies conducts a SWOT analysis at the January meeting.

TABLE 1 Top Issues in SWOT Analysis Results

STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
Active, diverse membership	Interaction with other committees	Collaboration with other committees and AQ community	Relevancy because of changes in AQ and technology; overlapping coverage of some topics by other committees
Paper review	Communication	Communications and social media	Low paper quality, weak diversity, lack of academic rigor
Research ideas and funding	Applicability of research to practice	Link research to practitioner's needs	Overemphasis on emissions modeling to the exclusion of other important topics

NOTE: SWOT = strength–weakness–opportunity–threat; AQ = air quality

In total, approximately 100 meeting participants helped the Transportation and Air Quality Committee complete its SWOT exercise. The top three issues in each category are shown in Table 1 (above). For example, although the committee has an active and diverse membership with robust processes for identifying research needs and reviewing papers, its research focus could be broadened and directed more strongly toward the needs of practitioners.

SUMMER 2018

With the SWOT analysis as groundwork, committee members organized a two-day summer meeting at the Keck Center in Washington, D.C., to complete the strategic planning process. The agenda included:

- Presentations on key issues, trends, and hot topics in air quality by some of the field's leading researchers;
- A review of the January 2018 SWOT analysis findings;
- Perspectives and priorities on research needs from industry, government, and research institution partners;
- Breakout sessions to discuss research priorities, the role of the Transportation and Air Quality Committee in pursuing these, and paths for new partnerships; and
- Breakout sessions to develop an action plan and measures of success for the committee.

Before the meeting, representatives of key research partners in the air quality field were asked to prepare statements on the top research priorities of their own organizations. These partners included the Federal Highway Administration (FHWA); the U.S. Department of Energy; the U.S. Environmental Protection Agency; Oak Ridge National Laboratory; the California Air Resources Board; the Health Effects Institute; and the Coordinating Research Council, a group focused on coordination of air quality research between the automotive and fuels industries. Representatives of related TRB committees, including the Transportation Energy Committee and Alternative Transportation Fuels and Technologies Committee, also prepared statements of priorities. During the meeting, approximately 50 transportation air quality experts convened to hear recent insights and contribute to the Transportation and Air Quality Committee's strategic planning efforts.

After the summer 2018 meeting, committee volunteers developed a summary documenting the findings of the gathering

Left: The transportation agencies breakout group at the January meeting considers committee priorities. Right: A breakout group discusses key issues and research needs at the summer meeting.

Understudied Transportation Air Quality Issues

- Health effects and regulatory responses of ultrafine particles;
- Air quality modeling chain: uncertainties, impacts on decision making, model simplification;
- Nonexhaust emissions: brake and tire wear;
- Why ozone levels have plateaued in some areas even as emissions are decreasing;
- Multipollutant hotspot analysis and spatial variability;
- The value of transportation air quality conformity practices; and
- Health effects: communication of risks and comparison with other risk factors and spatial and temporal variations.

Photo: Gillian Thomas, Flickr

United Kingdom's Fawley Power Station shut down in 2013 because of the financial and environmental cost of the oil-powered operation. Although some air quality issues have been addressed, new issues are emerging that need further research.

and included the SWOT analysis as an appendix.[2]

Findings

The changing landscape of transportation air quality research needs was a major theme of both the SWOT analysis and the summer 2018 meeting. Participants noted that, although some air quality issues have been addressed effectively, others are emerging as important areas of further study. Participants also recognized that the air quality issues of today and tomorrow are strongly intertwined with other transportation issues and that traditional sources of research funding for the committee, such as the National Cooperative Highway Research Program, are inadequate to address all current challenges. The action plan that emerged from the summer meeting placed a strong emphasis on partnerships with other committees, as well as coordination of priorities and activities among a diverse set of research partners.

> Practitioners would benefit from simplified approaches that still provide insights into key uncertainties affecting air quality outcomes.

Another theme was the importance of conducting research focused on the needs of practitioners. Although basic research often is important and necessary, applied problems cannot be overlooked. For example, modeling the air quality impacts of transportation investments and strategies can be a complex process, involving a chain of models that starts with transportation activity models and continue with emissions models and air pollutant dispersion models that estimate pollutant concentrations. But agency resources are finite, and sometimes great effort can be expended modeling very small impacts. Practitioners would benefit from simplified approaches that still provide insights into key uncertainties affecting air quality outcomes, with a focus on the information needed for decision-making. Committees such as the Transportation and Air Quality Committee provide an important forum for coordination between researchers and practitioners.

Action Items

The summer 2018 meeting summary identified several specific action items for the Transportation and Air Quality Committee, including the following:

[2] See "The TRB Air Quality Committee (ADC20) 2018 Summer Meeting Summary," available at www.trbairquality.org/the-trb-air-quality-committee-adc20-2018-summer-meeting-summary.

The ADC20 Summer Meeting Final Summary, including SWOT analysis findings, is available at the committee website at www.trbairquality.org.

- Circulating a call for papers in 2019 based on high-priority issues identified at the meeting;
- Expanding liaison and collaboration with other related committees and reviewing their relevant research needs statements to look for overlap and collaboration opportunities;
- Increasing the committee's off-road and nonhighway emissions analysis capabilities through membership, workshops, and focused research needs identification;
- Forming a working group to consider in more depth what the committee can do on international issues; and
- Creating a working group or subcommittee to compile, prioritize, and advance the list of research needs from the summer 2018 meeting by identifying and writing needed new research needs statements and matching these with potential funding sources.

Conclusion

TSPs provide a platform in which TRB committees can regularly reassess their activities and priorities. In preparation for its 2019 plan update, Transportation and Air Quality Committee members felt it was time to take a comprehensive look at the committee's activities and priorities and ensure they were responsive to the changing needs of both researchers and practitioners. A SWOT analysis at the TRB Annual Meeting in January was followed by summer meeting sessions to identify key issues and research needs, the role of the committee in meeting those needs, and future directions and action items. The process resulted in recommendations related to membership considerations; partnerships with other TRB committees and air quality research institutions; and steps to encourage research on priority topics through calls for papers, workshop sessions, and research needs statements.

TSPs provide a platform in which TRB committees can regularly reassess their activities and priorities.

This strategic review process can serve as a model for other TRB committees that wish to conduct comprehensive assessments of their own activities as they prepare to update their TSPs.

Committee chair Douglas Eisinger leads a planning discussion during the 2018 summer meeting.

Acknowledgments

The TRB Air Quality Committee benefited from the support of many volunteers who contributed to these strategic planning efforts: committee chair Douglas Eisinger, Sonoma Technology; summer meeting coordinator David Kall, FHWA; lead summer meeting summary author Christopher Porter, Cambridge Systematics; and lead SWOT analysis author Victoria Martinez, FHWA. Other volunteers include Richard Baldauf, U.S. Environmental Protection Agency; Alex Bigazzi, University of British Columbia; Georges Bou-Saab, Iowa State University; Robert Chamberlin, RSG; Michael Claggett, FHWA; Marianne Hatzopoulou, University of Toronto; Douglas Ito, California Air Resources Board; Razieh Nadafianshahamabadi, University of New Mexico; Jenny Narvaez, North Central Texas Council of Governments; Scott Peterson, Boston Region Metropolitan Planning Organization; Gregory Rowangould, University of New Mexico; Shams Tanvir, University of California, Riverside; and Mohammad Tayarani, University of New Mexico. Special appreciation is expressed to Christy Gerencher and Brie Schwartz, TRB, for their assistance throughout the planning process.

Committee Mission

The mission of the Standing Committee on Transportation and Air Quality is to provide leadership in research initiatives and knowledge sharing in the area of transportation related air quality issues. The committee does this by ensuring that up-to-date research needs are maintained, cross-cutting emerging issues are identified, critical issues are addressed in sessions and events, excellence in research is rewarded, and that the committee remains relevant and vibrant.

High-Performance Thin Asphalt Overlay Rises to Challenge

Pilot Project in Manhattan

Photo: John Weiss, Flickr

FRANK FEE

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Above: A 2012 plan to upgrade First Avenue in Manhattan required a new approach to rehabilitating the 53 city blocks.

Pavements in large cities are difficult to build and maintain. This is particularly true in New York City. In 2012, city planners wanted to upgrade First Avenue in Manhattan by adding a dedicated bus lane and separated bike lanes. The final project would require the rehabilitation of 53 city blocks—and 11,000 tons of asphalt mix.

The existing roadway was 18 inches of jointed concrete over variable bases, under which lay conduit for water, steam, and sewer piping, as well as electric and communication lines. The surface condition of this pavement was very poor, as seen in Figure 1 (below). Nearly every block had utility-cut patches and repairs of broken slabs. Patch material comprised more than half the surface on most of the blocks. Conventional pavement design practice for this distressed pavement structure might entail rubbilization, in which specialized equipment is used to break and fracture the concrete pavement into

(a) (b)

FIGURE 1 Typical condition on First Avenue (*a*) before repairs and (*b*) before overlay.

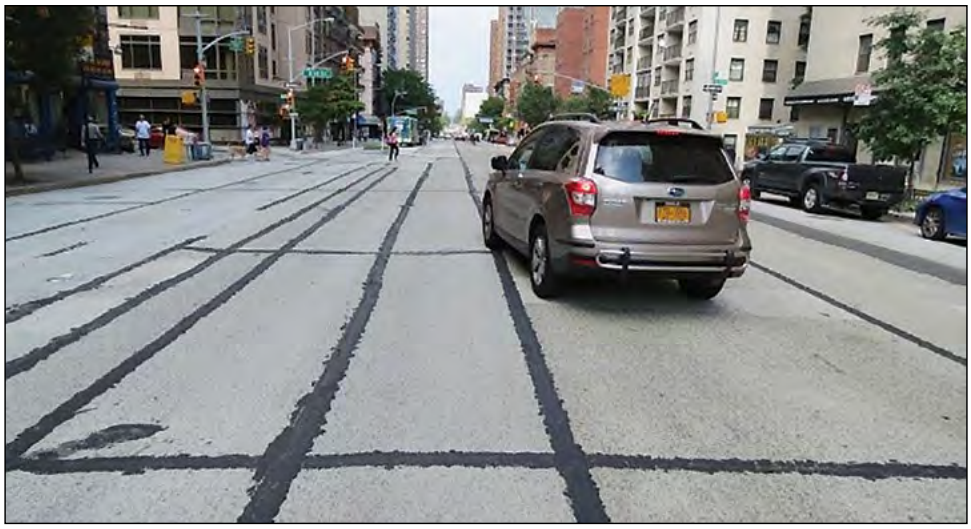

FIGURE 2 First Avenue milled, sealed, patched, and ready for overlay.

smaller pieces but is then left in place to provide a more uniform, baselike foundation before a new surface layer is added. Another conventional approach would be complete removal of the concrete and replacement with a newly reconstructed pavement section.

Both of these approaches, however, would impose several unacceptable parameters for New York City pavement managers. The methods would require the complete closure of blocks of First Avenue, and the disruption for the inhabitants of Manhattan would be intolerable for citizens and for city leaders. Additionally, any substantial removal of surface materials could possibly damage the underlying utilities. Curb and utility cover requirements prohibit the use of a thick asphalt overlay. The cost of these rehabilitation options also were well out of the city's budget.

Promising Applications

Recent work by the New Jersey Department of Transportation (DOT) on the development of high-performance thin overlay (HPTO) material showed promise for a new type of application. NuStar Asphalt had been working with advanced polymer-modified binders that showed promise in laboratory and limited field studies. Such HPTO applications offer higher performance than what ordinary paving materials can provide. They are placed over the patches and slabs that can concentrate stresses in the overlay. Subsequently, it was suggested to install some trial sections to see how this material would perform.

Public agencies and the industries they work with continually improve materials specifications for better pavement durability and longevity. The vast majority of asphalt mixes are approved by meeting a specific volume of stone aggregate, air voids, and asphalt binder; particular shape and size characteristics of the stone aggregate; and other requirements.

Strides have been made by implementing specifications that approve the type of asphalt binder that goes into the mixture based on engineering requirements and performance tests conducted on the binder; however, the combined mixture that gets placed on the roadway is not judged routinely for engineering performance. Unlike metals that are made in a factory, asphalt pavement materials have fewer degrees of separation between the product and the natural raw materials. Stone and sand can change characteristics depending on how deep they are taken from a particular quarry, not to mention differences among different quarry sites. The chemical nature of the petroleum used in binders also can change distinctly from well to well. Therefore, the natural variability in mixtures requires that tests on new mixture designs be conducted for each project and that recipes cannot be reused.

Performance-Related Asphalt Materials Specifications

Many nationwide efforts are in progress to develop the needed performance-based or performance-related asphalt materials specifications. National Cooperative Highway Research Program Project 9-57, Experimental Design for Field Validation of Laboratory Tests to Assess Cracking Resistance of Asphalt Mixtures, is one example (see sidebar, page 43).

The New Jersey DOT's prototype HPTO specification is another example. If a candidate mixture satisfies the extraordinary performance requirements, then it may be placed in special pavement applications such as First Avenue.

Project on First

Two exploratory HPTO sections were placed on two blocks of First Avenue in the fall of 2012. These sections were in very good condition 1 year later. With the highway department under pressure to get this

FIGURE 3 Night paving of First Avenue.

Experimental Design for Field Validation of Laboratory Tests to Assess Cracking Resistance of Asphalt Mixtures

NCHRP Project 09-57

In 2014, researchers from the Texas A&M Transportation Institute received a $250,000 contract from the National Cooperative Highway Research Program (NCHRP) to 1) select candidate laboratory tests for load- and environment-associated cracking applicable for routine use and 2) develop an experimental design for a series of coordinated field experiments to establish, verify, and validate laboratory-to-field relationships for the candidate tests and criteria for assessing the cracking potential of asphalt mixtures. The project was completed in 2016 and resulted in the following products:

- *NCHRP Research Results Digest 399: Field Validation of Laboratory Tests to Assess Cracking Resistance of Asphalt Mixtures: An Experimental Design*
- A workshop, held in February 2015 in Irvine, California, to select test methods for fatigue, reflective, and low-temperature cracking. An informative booklet describing the workshop candidate test methods is available at http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP09-57_TestBooklet.pdf

FIGURE 4 Completed First Avenue project.

project completed, they made the decision to move forward with the HPTO approach. The construction included micromilling the existing surface, joint sealing and patching with a hot applied polymer material, and applying a pavement fabric. This would be followed with a 1.5-in. application of special HPTO mix. Specifications were developed for materials and pavement preparation and placement of the mix for this project. Figure 2 (page 42) shows the surface after micromilling, joint sealing, and patching, but before placement of the fabric or HPTO overlay.

In fall 2013, the First Avenue project was completed. It was accomplished at night with minimal disruption of traffic (Figure 3, page 42). The asphalt mix also included a warm-mix technology (WMT), which allowed the placement temperature to be lower than normal. This meant that there were no visible emissions at the paving site and the pavement in-place density was very good. Figure 4 (top right) shows the project soon after completion, and Figure 5 visually compares First Avenue before any repairs and after a few years of service (below).

The development of advanced modified asphalt binders incorporated into new types of asphalt mixtures foretells the improved approaches to pavement rehabilitation design on the horizon. Older pavement structures can potentially be left in place, with only an appropriate, new surface replenishment. The savings in time, energy, materials, and cost is dramatic compared with the traditional total rehabilitation approach: the HPTO technique is less than 20% of the cost to remove and replace the old pavement, as well as the cost savings of reduced user delays from night paving.

The First Avenue project, even with the inevitable utility cuts, is still in very good condition and will be 6 years old this fall.

(a) (b)

FIGURE 5 Comparison of First Avenue (*a*) before overlay and (*b*) after a few years of service, June 2017.

DamageWise Program Implementation Pays Off for Indiana

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Above: Fort Wayne, Indiana.

Roadway infrastructure elements, such as guardrails, signs, and bridges, routinely sustain damage from motor vehicle crashes. Recovering the costs of repairing damage to state property from the parties responsible requires efficient business processes and public agency collaboration. Indiana Department of Transportation's (DOT's) implementation of the DamageWise program increased collections for repairs to damaged state property from $1.6 million in Fiscal Year (FY) 2010 to $7.3 million in FY 2018. The amount invoiced in FY 2018 was $9.0 million—an 81% collection rate.

Problem

Indiana DOT maintains approximately 11,000 miles of state roads. About 60,000 motor vehicle crashes per year occur on state-maintained roads; in approximately 4,000 instances, these crashes cause damage to state property. Indiana DOT incurs significant financial losses to repair the damage if the responsible parties cannot be identified, if invoices do not reflect the fully loaded cost of the repair, or if collection processes are not timely and efficient.

Solution

In 2009, Indiana DOT initiated a research project through Purdue University to examine business processes related to the repair of state property damaged by motor vehicle crashes. The research was conducted between October 1, 2009, and July 31, 2011, and cost $120,000. A review of the business processes of relevant parties—including law enforcement agencies, district maintenance departments, and collection departments—found several manual processes and often ambiguous linkages between crash reports, work orders, and damage invoices. Also conducted was a survey of other states to identify performance metrics and best practices. The Purdue–Indiana DOT research team recommendations focused on improving the efficiency and collaboration between public safety agencies and Indiana DOT when vehicle crashes damage state

property and are summarized in the final technical report (*1*).

Concurrent Research Implementation

Based on early research recommendations from the research team, in FY 2011 Indiana DOT initiated a statewide system called DamageWise. Deployment and implementation of DamageWise required cross-cutting team participation from district maintenance crews and supervisors, central office finance personnel, and information technology departments, as well as interagency partnerships with public safety and law enforcement colleagues. The DamageWise team was led by the DOT's deputy commissioner of finance and included district traffic engineers, district maintenance service directors, central office accounting staff, and unit foremen. A summary of the implementation activities is listed below.

LAW ENFORCEMENT PARTNERSHIP

The research team recommended that Indiana DOT implement a damage-tagging procedure that documents the investigating law enforcement agency, the crash date and time, and the crash report identification number. A highly visible, weather-resistant tag is attached to the damaged infrastructure at the time of the crash by the investigating officer and provides documentation to match the responsible party with the damage (see photo above).

A training and outreach program was developed to introduce this process to Indiana's law enforcement agencies. The Roadway Damage Tag kits provided to law enforcement agencies include all the materials needed to tag damaged property efficiently at the time of the crash (see photo at right).

DISTRICT MAINTENANCE ACTIVITIES

When maintenance crews identify damaged infrastructure and initiate a work order to repair damage, the identifying information from the damage tag is included, allowing the repair cost to be matched efficiently with the responsible party identified in the crash report.

Photo courtesy Indiana DOT

Law enforcement official applying damage tag to infrastructure damaged by motor vehicle crash.

FINANCIAL CLAIM TRACKING

The study also recommended that the damage collection process be more timely and include the fully loaded cost of the repairs. As a result, Indiana DOT implemented business processes that track damaged assets from field investigation through collection of repair costs from responsible parties.

Application

The DamageWise team integrated cost recovery activities into field employees' regular duties through a software program that is convenient, intuitive, and available for field use on portable wireless devices. DamageWise includes a range of policy and procedure changes designed to more effectively associate vehicle crash reports with crash-damaged infrastructure, ensure that invoices reflect the fully loaded repair cost, reduce the time it takes to produce invoices, and improve the documentation sent to responsible parties.

The DamageWise team coordinated with Indiana DOT information technology staff, Indiana State Police (ISP), and vendors to ensure that the ISP State Crash Report System interfaced with DamageWise. Indiana DOT Traffic Management Center personnel coordinated with ISP and local law enforcement agencies to conduct training and to solicit participation in the overall program. Indiana DOT district employees were assigned to oversee program activities, including identification, assessment, and submission of repair estimates to the accounting department.

A statewide DamageWise program coordinator assists with coordination, training, identification, and management

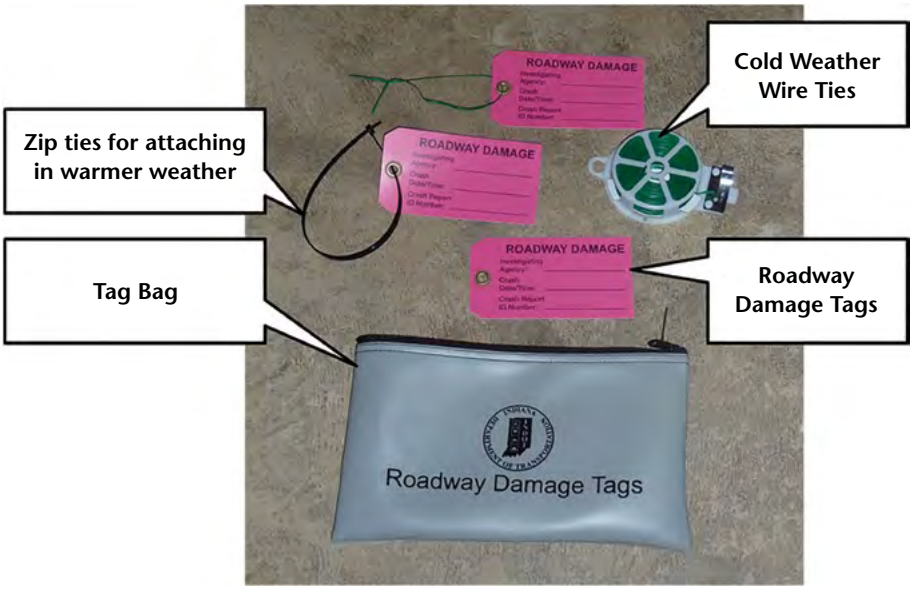


Photo courtesy Indiana DOT

Public safety tagging package, which costs $10.31 per bag.

of the process across the inter- and intra-agency partnerships that are critical to the success of DamageWise. In recognition of the collaborative effort required by DamageWise, in 2015 the program began distributing 75% of its roadway asset collections for claims less than $50,000 and 100% of collections for damage to mobile assets (e.g., trucks and attenuators) to the respective Indiana DOT districts who completed the repairs to the damaged property. This return rate was later increased; in 2018, 90% of the collections were distributed back out to the districts. Additional information about deployment and performance metrics of the DamageWise program can be found in a 2017 TRB paper by the authors of this article (*2*).

IMPLEMENTATION COSTS

The implementation costs of DamageWise totaled $826,000 over the first 3 years. This included the following: the implementation of software in 2011 ($140,000), a software enhancement in 2013 ($211,000), iPads ($42,000), and training and testing costs from FY 2011 through FY 2013 ($433,000).

ONGOING COSTS AND BENEFIT–COST RATIO

The ongoing costs for the DamageWise program are estimated to be $889,300 in FY 2018. These costs include approximately $858,300 in salaries for the central office and district personnel who administer the program and maintain the systems. Equipment replacement costs are estimated at $21,800 per year. Additional annual expenses include $5,100 for procurement costs and $4,100 for DamageWise kits. Adjusting the FY 2018 collections by the FY 2010 pre-DamageWise collections ($7.3 million versus $1.6 million) and applying the overhead costs ($889,300) resulted in a benefit–cost ratio of 6.4 for the DamageWise program in FY 2018.

Agency Benefits

Continuing success is documented by key performance measures and is dependent on partnerships that were established during the development and implementation of the DamageWise program. The collaboration with law enforcement agencies to tag damage when it occurs is critical to linking the damage to the responsible parties. Indiana DOT district personnel are essential partners in identifying the damage and initiating work orders for the repairs. Central processes to link the crash reports to the work orders, submit invoices, and follow up on the claims process involve coordinated efforts of Indiana DOT information technology and accounting personnel, as well as collaboration with Indiana's Attorney General Office.

Annual summaries of key performance indicators document the successful deployment and implementation of DamageWise throughout Indiana DOT. One measure is the number of days from the crash incident until an invoice is submitted to the responsible party. In 2010, the average crash-to-billing time was 227 days, which often led to challenges from the responsible parties and resulted in disputed claims. Following the implementation of DamageWise, the average crash-to-billing time dropped by 83% in FY 2015 to 38 days. In FY 2018, the elapsed time from crash to billing was less than one month.

Indiana DOT collected $1.6 million to cover repair costs in FY 2010 and collections have steadily increased to $7.3 million in FY 2018 (Figure 3). Indiana DOT has worked closely with the Indiana Attorney General Office to ensure that those invoices are collected. The amount invoiced in FY 2018 was $9.0 million—an 81% collection rate.

For more information, contact Daniel L. Brassard, Indiana Department of Transportation, 100 N. Senate Avenue, Indianapolis, IN 46204, at 317-232-1472 and dbrassard@indot.in.gov.

EDITOR'S NOTE: Appreciation is expressed to Claire Randall, Transportation Research Board, for her efforts in developing this article.

REFERENCES

1. Farnsworth, G. D., T. M. Brennan, and D. M. Bullock. Recovering Full Repair Costs of Indiana DOT Infrastructure Damaged by Motor Vehicle Crashes. Publication FHWA/IN/JTRP-2011/11. Joint Transportation Research Program, Indiana Department of Transportation and Purdue University, West Lafayette, Indiana, 2011. https://doi.org/10.5703/1288284314624.
2. Brassard, D. L., D. K. Horton, and D. M. Bullock. Applying Lean-Engineering Principles to Agency Business Processes to Improve Collections Associated with Infrastructure Damaged by Motor Vehicle Crashes. *Transportation Research Record: Journal of Transportation Research Board, No. 2670*, Transportation Research Board, Washington, D.C., 2017, pp 42–49. https://doi.org/10.3141%2F2670-06.

Suggestions for Research Pays Off topics are welcome. Contact Stephen Maher, Transportation Research Board, Keck 486, 500 Fifth Street NW, Washington, D.C., 20001; 202-334-2955; smaher@nas.edu.

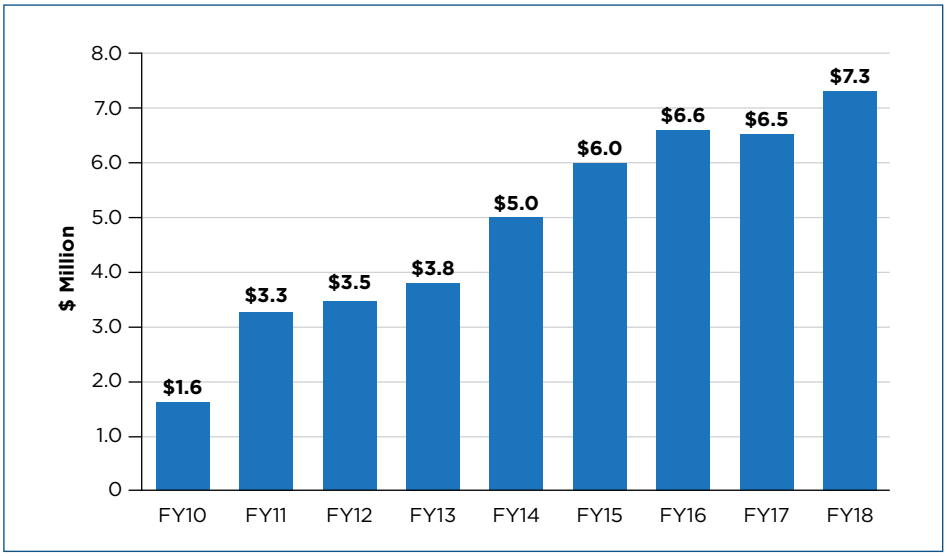


FIGURE 3 Annual collections before DamageWise (FY 10) and after DamageWise was fully implemented (FY 11–FY 18). (FY = Fiscal Year.)

DOTs Engage with Social Media

More and more, state departments of transportation (DOTs) rely on online social tools to pass on information and to engage the public. The American Association of State Highway and Transportation Officials (AASHTO) has issued its latest annual report on the subject, finding that social media now plays a critical, foundational role in state DOT communications.

AASHTO sent a survey to all 50 state DOTs, asking about the adoption of social media tools, the impact of social media use on the state agencies, and the influence of social media use on the relationship between the DOT and its customers. Forty-four DOTs responded.

Nearly half of the responding DOTs employ at least one staff member whose job is dedicated to social media—approximately twice as many DOTs as 6 years ago. Staff focus on content creation. Although fewer than 20% of DOTs formally monitor their social media sites, 70% will engage with individuals if asked a direct question. The survey looks at what media sites DOTs use most, which are best for pushing content and which are best for engaging, and how social media is influencing communication strategies.

To read the report, visit https://communications.transportation.org/wp-content/uploads/sites/2/2018/10/2018-Social-Media-Survey_web.pdf.

Transit Use Reduces Obesity Rates

A new study by researchers from the University of Illinois at Urbana–Champaign and Georgia Tech outlines the health benefits of transit use. Unlike driving a car, taking transit often involves walking, from home to bus stops and from bus stops to destinations. "Opting for mass transit over driving creates opportunities for exercise that may not otherwise exist," commented study coauthor Sheldon H. Jacobson.

The study, published in *Transportation Research Part A: Policy and Practice*, analyzes census data across 227 counties from 45 states between 2001 and 2009. Included in the data were household income, healthcare coverage, exercise, and public transit funding. The analysis showed a correlation between increased transit ridership and lower obesity rates—a single percentage-point increase in ridership decreased obesity rates by nearly half a percentage point.

Researchers note that the analysis is at the county level—that is, as more people ride transit, the overall obesity rate drops, not necessarily that transit use reduces obesity on an individual level.

For more information, visit www.metro-magazine.com/bus/news/732854/lower-obesity-rates-linked-with-public-transportation-use-study-shows.

Lack of Infrastructure Investment Hampers Bridge Repair

Every day, 178 million vehicles cross over structurally deficient bridges in the United States, including New York's Brooklyn Bridge; the Memorial Bridge in Washington, D.C.; and San Francisco's San Mateo–Hayward Bridge. The American Road and Transportation Builders Association's (ARTBA's) 2019 *Bridge Report* identifies bridges in need of repair, examines the economics associated with infrastructure needs, and presents trends in funding and bridge classifications.

According to the U.S. DOT guidelines, a bridge is classified as "structurally deficient" if any of the components—deck, superstructure, substructure, or culvert—are rated in poor or worse condition. Using data from the National Bridge Inventory database, ARTBA analyzed the pace of infrastructure improvement, estimating the cost to repair deficient bridges as $171 billion—nearly a third of which would be needed for bridge replacement.

Although the percentage of structurally deficient bridges has declined by nearly one percent over the past 5 years, the rate of bridge improvements has slowed. ARBTA estimates that current necessary repairs would take 80 years at the current level of investment.

For a full ranking of structurally deficient bridges by state and to read the full economic reports, visit https://artbabridgereport.org/.

INTERNATIONAL

Clear Safety Increases for Children

In 2010, more than 17,000 children under the age of 13 were involved in traffic accidents in Korea—760 of those in school zones. When statistics showed that the risk of accidents increased significantly when it was raining, auto-parts maker Hyundai Mobis began a traffic safety campaign to increase child pedestrian safety by distributing clear umbrellas.

Since 2011, Hyundai Mobis has distributed 900,000 clear umbrellas and provided safety education to children across Korea. Children are less attentive than adults and are not able to make quick judgments, leaving them more vulnerable to traffic accidents—especially when umbrellas obstruct their view. The clear umbrellas, which include reflective material to make them more visible to drivers, allow children to be more aware of their surroundings.

A study of the program, recently published by Korea's traffic authority, showed a sharp decline (27%) in injuries and deaths among children participating in the transparent umbrella program—four times more than the national average. The company is bringing the program to U.S. schools this year.

For more information, visit www.koreatimes.co.kr/www/tech/2019/01/419_262938.html.

Patricia S. Hu

Bureau of Transportation Statistics

"My extensive and long-term involvement with the transportation research community has provided me with an everlasting learning environment in which to constantly hone my research ability."

Patricia (Pat) S. Hu trained as a biostatistician, receiving a bachelor's degree in statistics from Chengchi University in Taiwan and a master's degree in statistics from the University of Guelph in Canada. More than 35 years ago, her career focus shifted to transportation. Over the course of a transportation career that led from the Center for Transportation Analysis at Oak Ridge National Laboratory (ORNL) in Tennessee to the U.S. Department of Transportation's Bureau of Transportation Statistics (BTS), Hu has led many applied research projects, published extensively, and received the TRB Pyke Johnson Award in 1984.

Since her appointment in 2011 as Director of BTS, Hu has directed the federal statistical agency to enhance the relevance, quality, timeliness, coverage, accessibility, and availability of transportation statistics to inform transportation decisions. "The 1991 Intermodal Surface Transportation Efficiency Act established BTS as one of 14 federal statistical agencies whose mission was to be a policy-neutral, objective information broker," Hu comments. "In recent years, BTS has been recognized as a leader in freight statistics, transportation economics, and airline information."

With recent advances in data analytics and an explosion of available data from the Internet of Things—for example, data from the real-time traffic app Waze and automatic vessel tracking data—Hu has directed BTS's focus toward exploring alternative data sources and innovative collection techniques to fill long-term data gaps and developing visual analytics to distill insights from massive amounts of data now available.

Between 1982 and 2011 Hu's research at ORNL, a U.S. Department of Energy multidisciplinary research laboratory, mainly investigated personal travel behavior, traffic reliability, and safety and security. For almost 10 of those years, she served as director of the Center for Transportation Analysis, developing policy studies and scalable system solutions to address a wide range of transportation issues. These efforts included research that informs and shapes national clean energy policy, system development that prioritizes inland waterway infrastructure investments, and evaluation of the potential impact of policies and technologies on elderly driver safety.

"Rewardingly, ORNL allowed me the opportunity to leverage and collaborate with outside-the-box technologies and expertise to develop innovative, holistic solutions," Hu notes, citing the example of nanomarkers and geofencing techniques that were combined to track fuel flow to minimize fuel loss and fuel tax evasion. "The success of this research was reflected in demands to use this solution from the private sector and the military transportation command."

Hu has been engaged with TRB for many years, first joining the Transportation Data and Information Systems Committee in 1992. She has served on the National Research Council Committee for the National Tire Efficiency Study and on the Committee on Planning for Catastrophe: A Blueprint for Improving Geospatial Data, Tools, and Infrastructure and on the Long-Term Pavement Performance Program Committee. She also served on the Technical Coordinating Committee for Reliability Research with the second Strategic Highway Research Program, overseeing the completion of two reliability projects.

Hu has been a member of more than 30 TRB standing committees and National Cooperative Highway Research Program project panels. She currently serves as cochair of the Review Advisory Board of the *Transportation Research Record: Journal of the Transportation Research Board* and as a member of the Standing Committee on Performance Management and the Task Force on Data for Decisions and Performance Measures.

Hu also has served the research community widely at the international level, from the editorial advisory boards of the international journals *Accident Analysis & Prevention and the Journal of Transportation and Statistics* to the Organisation for Economic Co-operation and Development's International Transport Forum (ITF) in Paris, France. Since becoming involved with ITF in 2012, Hu has led many research initiatives, including a task force that developed the report *Understanding the Value of Transport Infrastructure*, the Working Group on Big Data and Open Data, and the Working Group on Transportation Satellite Accounts. She also has chaired ITF's International Transport Statistics Annual Meeting since 2013.

"My extensive and long-term involvement with the transportation research communities such as TRB and ITF has provided me with an everlasting learning environment in which to constantly hone my research ability," Hu observes. "These communities have also presented me the unique opportunity to appreciate the importance of diversity—from different disciplines, different perspectives, and even different countries—to the development of meaningful, useful, implementable and holistic solutions." Because of these experiences, Hu believes that a successful applied researcher is one who keeps abreast of frontier knowledge; learns from failures; remains open-minded to the thinking of future generations; and expands one's tool box through collaborative innovation.

Åsa Vagland

Ministry of Infrastructure, Sweden

As senior adviser and deputy director at the Swedish Ministry of Infrastructure in Stockholm, **Åsa Vagland** is responsible for such emerging technologies as connected, cooperative, shared, and automated mobility, as well as mobility as a service. She also manages the Swedish Prime Minister's Innovation Partnership Programme in next-generation travel and transportation and develops policy and strategies for transport and mobility as well as gender objectives and gender mainstreaming in the transportation sector. Vagland also serves as the Swedish representative to the European Union Platform for Change: Women in Transport.

"Research and innovation are crucial for the development of the transport sector—especially in tackling climate change and achieving the Paris Climate Agreement of 2016," Vagland affirms.

Vagland earned a degree in social science from Farsta Gymnasium, an upper secondary school outside Stockholm. She lived in Kansas as a high school exchange student, and received her university degree in regional, transportation, and societal planning from the University of Stockholm.

Vagland began her career as a traffic planner for the County of Stockholm. She joined a consulting firm in 1993 as a project manager, guiding city, regional, and national transportation planning and analysis projects. She developed the transportation section of the comprehensive plan for Kimberley, South Africa, and other projects in Latvia and Lithuania. In 2001, Vagland became expert adviser at the Swedish Institute for Transport and Communications Analysis, where she was responsible for developing Swedish transport policy objectives, managing the annual report on these objectives, and many other policy development assignments.

In 2004, Vagland joined the Swedish National Road and Transport Institute as expert adviser, and in 2007, the agency VINNOVA as manager of the research and innovation program Future Public Transport. In 2012, she became special adviser at the Ministry of Enterprise and Innovation, then called the Ministry of Enterprise, Energy and Communications.

Vagland notes that the Swedish Parliament has set the ambitious goal of reducing greenhouse gas emissions from domestic transportation by 70% by 2030 and that Sweden should be the first fossil fuel–free welfare nation. "In order to achieve this, Sweden—and the rest of the world—needs to find new solutions for the whole transport and mobility system," Vagland comments. "New emerging technologies for connected, cooperative, automated, and electric vehicles and systems are crucial—but so are new solutions for sharing and new business models."

"Research can provide the rigor required to build a solid foundation of knowledge on which to formulate the next hypothesis and test it."

In 2010, Vagland joined the Women's Issues in Transportation Committee at TRB. A longtime member of that committee, she currently cochairs the Subcommittee on Mainstreaming Global Research and Multifaceted Data Collection on Gender Issues in Transportation. She helped to plan the 5th International Conference on Women's Issues in Transportation (WIiT) in 2014 and is preparing for the 6th WIiT this year. "Research and innovation results need to be spread and shared throughout the world—and TRB is doing a great job with this," Vagland observes. "The European Framework Programme for Research and Innovation has an important role to finance and to convene European researchers doing research in teams and sharing their different experiences," she adds.

In 2002, together with a couple other women in transport policy in Sweden, Vagland founded the Network for Women in Transport Policy, now called Network Jämställdhet i transportsektorn (Gender Equality in the Transport Sector). She served as the network's president from 2003 to 2006 and still sits on the election board. "We have a responsibility to engage more women in the transport sector, as researchers, workers, decision makers, and politicians, and in all different roles and positions," Vagland comments. "We need the perspectives from the whole population to create a transport system that is not only sustainable but also suitable and accessible for all. We need to analyze the consequences of decisions taken within the transport sector on the needs and values of women and men." She adds that to be able to do that, all statistics and data collections should be separated by gender.

Among Vagland's research papers are "Gender Equality as a Subsidiary Objective of Swedish Transport Policy: What Has Happened Since 2004?," presented at the 4th WIiT in 2009; "The Development of Public Attitudes Towards the Stockholm Congestion Trial," published in *Transportation Research Part A* in 2009; and "Gender Equality as a Subsidiary Objective of Swedish Transport Policy," presented at the Transport Research Arena in 2006.

COOPERATIVE RESEARCH PROGRAMS

Using Existing Airport Management Systems to Manage Climate Risk

ACRP Research Report 188

CASSANDRA BHAT, TOMMY HENDRICKSON, BETH RODEHORST, AMANDA VARGO, AND LAUREN SEYDEWITZ

Bhat is Climate Adaptation and Resilience Manager, ICF, Miami, Florida; Hendrickson is Climate Change and Sustainability Specialist, ICF, San Francisco, California; Rodehorst is Climate Resilience Director, ICF, Portland, Oregon; Vargo is Climate Resilience Specialist, ICF, Washington, D.C.; and Seydewitz is Environmental Scientist, Gresham Smith, Providence, Rhode Island.

Airports manage risk—including risks related to climate and weather—using such programs and decision-making processes as enterprise risk management, safety management, and emergency management. Additional processes like asset management, capital planning, and others also manage risk by allocating resources and designing and maintaining assets to reduce an airport's vulnerability to certain stressors.

Assumptions about climate and weather are built into most airport management systems. Budget planning, for example, involves assumptions about how much infrastructure maintenance or replacement is needed to counteract effects of climate and weather. Emergency management and irregular operations planning involves assumptions about events that might disrupt operations.

Expectations for future climate and weather conditions usually are based on historical records; however, climate change means that past events are not indicative of future events. If climate change is not accounted for, expensive airport infrastructure would be inadequately designed for future needs and the airport could be underprepared for extreme weather events and associated service disruptions. In addition, other financial and operational planning efforts might be impaired.

A DIFFERENT APPROACH

Rather than considering climate change as a new and separate risk to address, airports can integrate climate change considerations into their existing decision-making processes to ensure that climate risks are adequately managed. Approaching climate change in this way allows airports to make more informed decisions about appropriate investments to mitigate risks over time.

No universal best practices or guidelines on managing climate risk are available to airports, however. Without an integrative resource for airports, climate risks can be viewed as abstract and unquantifiable—resulting in missed opportunities. Airports also may not be aware of the full range of climate risk factors that should be included in their multihazard risk management processes.

Quick-start guide for strategic planning with climate entry points and integration actions.

To help overcome this barrier, the Airport Cooperative Research Program (ACRP) has released *ACRP Research Report 188: Using Existing Airport Management Systems to Manage Climate Risk*. This report includes a handbook that helps airports understand the need to address climate change and demonstrates how climate change can be factored into their decision-making processes. The handbook includes a self-assessment tool for determining applicable management systems for climate-related decision-making within the airport, a detailed guide for integrating climate risks into seven key management systems, and strategies for building support across the airport. The seven management systems include the following: strategic planning, master planning, enterprise risk management, safety management, capital planning, asset management, and emergency management.

The report was developed under ACRP Project 02-74, with research conducted by ICF, led by principal investigator Beth Rodehorst; Gresham Smith & Partners; and Faith Group, LLC. Initial insights into the state of practice and key management systems for climate risk management were obtained through a literature review and webinars with airport stakeholders. Based on this initial research, *ACRP Research Report 188* was tested and vetted through several airport focus groups and site visits. An accompanying quick-start guide covers the most critical portions of the handbook; airports may choose to use the quick-start guide as a starting point and then refer to the handbook for more detailed information as needed.

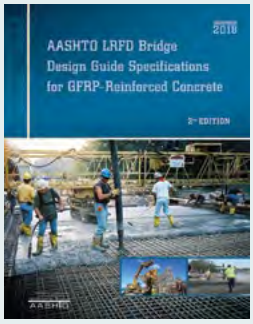
NATIONAL ACADEMIES INITIATIVES

Engaging Engineering Societies in Undergraduate Engineering Education

Over the past 2 years, the National Academy of Engineering (NAE), with support from the National Science Foundation, took an in-depth look at engineering societies' role and contributions to improving the effectiveness and quality of undergraduate education. This initiative offered an opportunity for the societies to convene with universities and industry to share insights, learn what others are doing, and explore possible collaborations. To date, there have been five workshops and publications that have resulted from these efforts. These have included the following:

- Held in January 2017, the first workshop, Engineering Societies and Undergraduate Education, was based on a literature review, analysis of engineering society websites, survey of engineering societies, and follow-up interviews about what the societies are doing in undergraduate engineering education. This workshop convened more than 80 academics and engineering society officials who discussed issues and shared ideas on collaboration among their societies and undergraduate engineering education. The resulting conference proceedings can be found at www.nap.edu/catalog/24878.
- The second workshop, held in September 2017 and called An Undergraduate Competition Based on the Grand Challenges for Engineering, explored the possibility of an undergraduate student competition based on the NAE Grand Challenges for Engineering, a cross-disciplinary initiative to use engineering to address the biggest challenges facing humanity. The competition was discussed as a way to engage, recruit, retain, and prepare undergraduates for engineering careers, and engage professional societies with undergraduates. For more information, see www.nap.edu/catalog/25018.
- The workshop Engineering Societies and Facilitating Measures of Faculty Impact in February 2018 explored the role of engineering societies in enhancing understanding of faculty impact on the engineering profession as part of the reappointment, promotion, and tenure process. https://www.nap.edu/download/25181. For more information, visit www.nap.edu/download/25181.
- The workshop Engineering Societies' Activities in Promoting Diversity and Inclusion in June 2018 explored how engineering societies can promote diversity and inclusion in engineering, provide an opportunity for societies to share promising practices, and investigate possible collaborative actions. The report can be downloaded at www.nap.edu/download/25323.

—Kenan Jarboe
Senior Program Officer,
National Academy of Engineering



AASHTO Load and Resistance Factor Design Bridge Design Guide Specifications for GFRP-Reinforced Concrete, 2nd Edition

American Association of State Highway and Transportation Officials (AASHTO), 2018; 121 pp. Free downloadable PDF at https://store.transportation.org/Item/PublicationDetail?ID=4148.

These guide specifications offer a description of the unique material properties of glass fiber-reinforced polymer (GFRP) composite materials, as well as provisions for the design and construction of concrete bridge decks and traffic railings reinforced with GFRP reinforcing bars. This revised edition includes information beyond bridge decks and railings and considers advancements in material specifications.

Guidelines for the Use of Reclaimed Asphalt Shingles in Asphalt Pavements, 2nd Edition

National Asphalt Pavement Association, 2019; 38 pp. Free downloadable PDF at http://store.asphaltpavement.org/index.php?productID=766.

Asphalt roof shingles often end up in landfills—but they can be reclaimed for use in new roads, parking lots, and other asphalt pavements. These guidelines cover sourcing shingles, inspection for contaminants, processing, and binder adjustments, as well as examining the economic benefits of using reclaimed shingles. This edition includes new research and best practices.

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

TRB PUBLICATIONS

Highway Capacity and Quality of Service 2018
Transportation Research Record 2672, Issue 15

Authors present research on the capacity of roundabouts, saturation flow models for signalized intersections, traffic operation on rural highways, use of probe vehicle data to assess highway travel time, among other topics.

2018; 154 pp. For more information, visit http://journals.sagepub.com/home/trr.

Visibility and Work Zone Traffic Control 2018
Transportation Research Record 2672, Issue 16

Traffic flow modeling of diverse work zones, use of variable speed limits in construction zones, work zone intrusion alarm systems, and the impacts of sun glare and fog are a few of the topics examined in this issue.

2018; 121 pp. For more information, visit http://journals.sagepub.com/home/trr.

Operational Effects of Geometric and Access Management 2018
Transportation Research Record 2672, Issue 17

Papers in this issue include such topics as crash rates in interchanges, the safety of signalized intersections, the effect of expressway curve radius on drivers' speeds, and the Texas U-turn at diamond interchanges.

Articles for Issues 1–3 of TRR Volume 2673 (2019) are now online. Beginning this year, TRR will publish one interdisciplinary issue monthly. Individual articles will be released as available and compiled into the issue at the end of the month. Readers will be able to choose to access either the complete issue or individual articles. For more information, visit http://journals.sagepub.com/home/trr.

2018; 139 pp. For more information, visit http://journals.sagepub.com/home/trr.

Traffic Signal Systems 2018
Transportation Research Record 2672, Issue 18

Traffic signal systems, such as the arterial-based transit signal priority control system, the peer-to-peer priority signal control in connected vehicles, real-time detector-free adaptive signal control, and signal priority request delay for emergency vehicles, are explored in this issue.

2018; 178 pp. For more information, visit http://journals.sagepub.com/home/trr.

Intelligent Transportation Systems 2018
Transportation Research Record 2672, Issue 19

The use of various types of intelligent transportation systems, such as those used in connected vehicles and at signalized intersections, as well as the impacts of those systems, issues with cybersecurity, planning strategies, and safety are examined in this issue.

2018; 156 pp. For more information, visit http://journals.sagepub.com/home/trr.

Traffic Flow Theory and Characteristics 2018
Transportation Research Record 2672, Issue 20

This issue presents research on the sizing of curbside parking lanes, lane change risks, perimeter control as an alternative to dedicated bus lanes, merging pedestrian crowds, and driver merging behavior, among many others.

2018; 276 pp. For more information, visit http://journals.sagepub.com/home/trr.

Traffic Control Devices 2018
Transportation Research Record 2672, Issue 21

The six papers in this issue explore traffic control devices and their safety effects and impacts.

2018; 61 pp. For more information, visit http://journals.sagepub.com/home/trr.

Connected and Automated Vehicles
Transportation Research Record 2672, Issue 22

Topics related to connected and automated vehicles, including the necessity for control customization; lessons learned from real-world deployment; adaptive cruise control operations; safety in stop assist systems; and automated vehicle, bicycle, and pedestrian communication are examined in this issue.

2018; 77 pp. For more information, visit http://journals.sagepub.com/home/trr.

Aviation
Transportation Research Record 2672, Issue 23

This issue explores aviation-related research, including the impact of airline mergers and consolidations; pricing impacts; traffic organization methods; emission reduction potential; and the world's first full-scale electrically conductive, concrete heated pavement system.

2018; 157 pp. For more information, visit http://journals.sagepub.com/home/trr.

Environment and Energy
Transportation Research Record 2672, Issue 24

Bridges as habitats for bats, cold-in-place recycling, pathways toward zero-carbon campus commuting, and noise barriers are among the topics examined in this issue.

2018; 153 pp. For more information, visit http://journals.sagepub.com/home/trr.

Air Quality
Transportation Research Record 2672, Issue 25

The 16 papers presented in this issue include research on the impact of idle reduction technologies on driver exposure to emissions, the potential of metering roundabouts, and the effect of light-duty vehicle performance on a driving style metric.

2018; 186 pp. For more information, visit http://journals.sagepub.com/home/trr.

Construction
Transportation Research Record 2672, Issue 26

Construction financing, communications, design development, and new technologies and materials are examined in the papers presented in this issue.

2018; 164 pp. For more information, visit http://journals.sagepub.com/home/trr.

Concrete Materials
Transportation Research Record 2672, Issue 27

The uses of fiber-reinforced concrete, the repair of cast-in-place concrete, the sustainability of concrete aggregate, and the durability of portland cement concrete are among the topics explored in this issue.

2018; 108 pp. For more information, visit http://journals.sagepub.com/home/trr.

Asphalt Mixtures and Materials
Transportation Research Record 2672, Issue 28

Forty-seven articles presenting research on asphalt mixtures and materials are included in this issue, presenting research on the impact of reclaimed asphalt shingles on field performance, the performance of plant-produced high-reclaimed asphalt, and a comparison of field performance among various warm-mix asphalt pavements, and more.

2018; 513 pp. For more information, visit http://journals.sagepub.com/home/trr.

Highway Safety Performance and Statistical Methods
Transportation Research Record 2672, Issue 30

Evaluations for SafetyEdge treatments for pavement drop-offs, the safety effects of span wire to mast arm signal conversion, and the realignment of horizontal curves on rural two-lane roads are among the 14 topics explored in this issue.

2018; 152 pp. For more information, visit http://journals.sagepub.com/home/trr.

Guide for the Analysis of Multimodal Corridor Access Management
NCHRP Research Report 900

The operational and safety relationship between access management techniques and the automobile, pedestrian, bicycle, public transit, and truck modes are explored in this report.

2018; 126 pp.; TRB affiliates, $58.50; nonaffiliates, $78. Subscriber categories: pedestrians and bicyclists, operations and traffic.

Benchmarking and Comparative Measurement for Effective Performance Management by Transportation Agencies
NCHRP Research Report 902

This report presents practical guidance on how transportation agencies can undertake benchmarking to improve system performance management practices for active (e.g., nonmotorized) transportation and environmental impacts.

2019; 160 pp.; TRB affiliates, $63.75; nonaffiliates, $85. Subscriber categories: administration and management, planning and forecasting.

Using Disaggregated Socioeconomic Data in Air Passenger Demand Studies
ACRP Research Report 194

This report explores the potential benefits of using disaggregated socioeconomic data, such as regional household income distributions and air passenger and travel survey data, and summarizes long-term socioeconomic trends, attempts to understand the potential impact of these trends, and offers guidance for incorporating disaggregated socioeconomic data into air passenger demand studies.

2019; 134 pp.; TRB affiliates, $60; nonaffiliates, $80. Subscriber categories: aviation, economics.

Guidebook for Developing a Comprehensive Renewable Resources Strategy
ACRP Research Report 197

Renewable energy sources are highlighted in this report. Also included are steps for developing a renewable energy strategy, metrics for measuring success, and successful real-world examples of airport projects.

2019; 152 pp.; TRB affiliates, $63.75; nonaffiliates, $85. Subscriber categories: aviation, environment, energy.

Public Transit Rider Origin–Destination Survey Methods and Technologies
TCRP Synthesis 138

This synthesis presents the reality and complexity of conducting origin–destination surveys and will allow agencies to compare their methods with those of other agencies, get ideas about possible strategies, and make better survey decisions in the future. Five case examples are included.

2019; 170 pp.; TRB affiliates, $63.75; nonaffiliates, $85. Subscriber categories: public transportation, administration and management, planning and forecasting.

Transit Service Evaluation Standards
TCRP Synthesis 139

This synthesis provides an overview of the purpose, use, and application of performance measures, service evaluation standards, and data-collection methods at North American transit agencies. It covers agencies of different sizes, geographic locations, and modes.

2019; 140 pp.; TRB affiliates, $60; nonaffiliates, $80. Subscriber categories: public transportation, administration and management, passenger transportation.

Microtransit or General Public Demand–Response Transit Services: State of the Practice
TCRP Synthesis 141

Presented in this synthesis is a literature review and results from a survey of 22 transit agencies with microtransit services using their own vehicles and personnel or using contractors. Case examples are provided, with in-depth analysis and keys to success.

2019; 222 pp.; TRB affiliates, $71.25; nonaffiliates, $95. Subscriber categories: public transportation, administration and management, passenger transportation.

Implementing the U.S. DOT Reasonable Modification Rule
TCRP Synthesis 142

This synthesis offers an overview of the state of practice regarding implementation of the U.S. Department of Transportation's (DOT's) Americans with Disabilities Act of 1990 Regulation 49 C.F.R. Part 37. Included are letters of complaint and discussions on responses, as well as six case examples of transit agencies who routinely modify as a matter of practice.

2019; 158 pp.; TRB affiliates, $63.75; nonaffiliates, $85. Subscriber categories: public transportation, administration and management, passenger transportation.

To order the TRB titles described in Bookshelf, visit the TRB online bookstore, www.TRB.org/bookstore, or contact the Business Office at 202-334-3213.

TRB STANDING COMMITTEES

June

25–27 17th Biennial National Harbor Safety Committee Conference
Houston, Texas

July

8–11 Southern African Transportation Conference (SATC)*
Pretoria, South Africa

9–12 17th Biennial Conference on Transportation Energy and Policy*
Pacific Grove, California

14–18 2019 AASHTO Highway Maintenance Conference*
Grand Rapids, Michigan

14–16 Resource Conservation and Recovery Committee Workshop
Washington, D.C.

15–18 Automated Vehicles Symposium 2019: Advanced Registration Ends June 10, 2019*
Orlando, Florida

21–24 58th Annual Workshop on Transportation Law
Cleveland, Ohio

21–24 American Society of Civil Engineers (ASCE) 2019 Airfield and Highway Pavements Conference*
Chicago, Illinois

21–24 Geospatial Data Acquisition Technologies in Design and Construction Midyear Meeting
Daytona, Florida

21–26 Joint Meeting of the AASHTO Committee on Design and Council on Active Transportation and TRB Roadside Safety Design Committee*
Reno, Nevada

22–24 Bridge Engineering Institute Conference 2019*
Honolulu, Hawaii

August

4–7 9th International Conference on Structural Health Monitoring of Intelligent Infrastructure*
St. Louis, Missouri

September

10–13 6th International Conference on Women's Issues in Transportation
Irvine, California

12–18 12th International Conference on Low-Volume Roads
Kalispell, Montana

15–19 Conference on Performance and Data in Transportation Decision Making
Atlanta, Georgia

29–Oct. 2 3rd International Conference on Information Technology in Geo-Engineering*
Guimaraes, Portugal

October

6–10 PIARC 26th World Road Congress
Abu Dhabi, United Arab Emirates

21 TRB Workshop at the 69th Highway Geology Symposium*
Portland, Oregon

23–24 Air & Waste Management Association Conference on Freight and Environment: Ports of Entry*
Newark, New Jersey

Additional information on TRB meetings, including calls for abstracts, meeting registration, and hotel reservations, is available at www.TRB.org/calendar, or by e-mail at TRBMeetings@nas.edu.

UPCOMING WEBINARS

June

10 Simple *Highway Capacity Manual* Analysis Tools for Planning Applications

11 Communications Strategies for Talking Tolls and Public–Private Partnerships

13 Limitations of Drug Fatality Data

For more information, contact Elaine Ferrell, TRB, at 202-334-2399 or eferrell@nas.edu.

CONSENSUS AND ADVISORY STUDIES

July

14–15 Forum on Preparing for Automated Vehicles and Shared Mobility
Orlando, Florida

August

4 Federal Highway Administration Emerging Trends Symposium
Washington, D.C.

14–15 Mobility Management Study Committee Meeting
Dallas, Texas

November

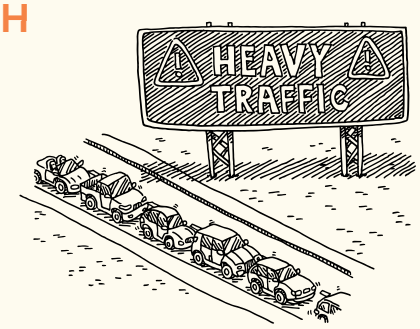
6–7 Marine Board Fall 2019 Meeting
Woods Hole, Massachusetts

For more information on these events, e-mail Michael Covington, TRB, at mcovington@nas.edu.

To subscribe to the TRB E-Newsletter and keep up to date on upcoming activities, go to www.trb.org/Publications/PubsTRBENewsletter.aspx and click on "Subscribe."

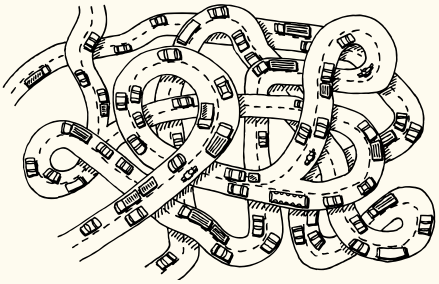
*TRB is cosponsor of the meeting.

COOPERATIVE RESEARCH PROGRAMS



National Cooperative Highway Research Program (NCHRP) FY 2020 panel nominations are due **Thursday, June 20**.

For more information, visit www.trb.org/NCHRP/NCHRPOverview.aspx.

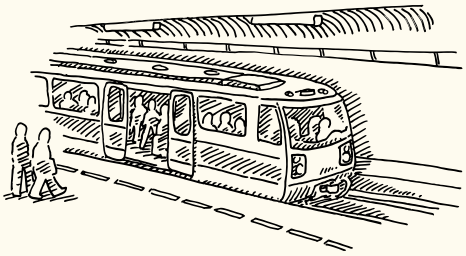


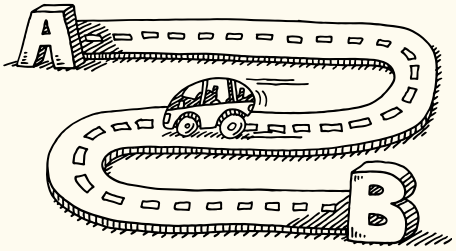
NCHRP Synthesis Program panel nominations and letters of interest are due **Wednesday, July 31**.

For more information, visit www.trb.org/SynthesisPrograms/SynthesesNCHRP.aspx.

The Transit Cooperative Research Program (TCRP) issued a call for problem statements in January 2019. Problem statements are due **Friday, June 14**.

For more information, visit www.trb.org/TCRP/TCRPGettingInvolved.aspx.





TCRP Synthesis Program panel nominations and letters of interest are due **Friday, June 28**.

For more information, visit www.trb.org/SynthesisPrograms/ProjectonSynthesisofInformationRelatedtoTransitPro.aspx.

The Behavioral Traffic Safety Cooperative Research Program panel nominations and letters of interest are due **Monday, July 22.**

For more information, visit www.trb.org/BTSCRP/BTSCRP.aspx.

NASEM EVENTS

June

6–7 **Challenges and New Approaches for Protecting Privacy in Federal Statistical Programs: A Workshop**
National Academy of Sciences Building, 2101 Constitution Ave. NW, Washington, D.C.

For more information, contact Jillian Kaufman at jkaufman@nas.edu or 202-334-3465.

11–12 **Government–University–Industry Research Roundtable Meeting: Transformational Impact of 5G**
Keck Center, 500 5th St. NW, Washington, D.C.

For more information, contact Megan Nicholson at guirr@nas.edu.

13–14 **Health-Focused Public–Private Partnerships in the Urban Context**
National Academy of Sciences Building, 2101 Constitution Ave. NW, Washington, D.C.

For more information, contact Claire Moerder at cmoerder@nas.edu or 202-334-3264.

26 **Hydrogen Fueling Infrastructure Webinar**

For more information, contact Elizabeth Zeitler at ezeitler@nas.edu or 202-334-1926.

INFORMATION FOR CONTRIBUTORS TO

TR NEWS

TR News welcomes the submission of manuscripts for possible publication in the categories listed below. All manuscripts submitted are subject to review by the Editorial Board and other reviewers to determine suitability for *TR News*; authors will be advised of acceptance of articles with or without revision. All manuscripts accepted for publication are subject to editing for conciseness and appropriate language and style. Authors receive a copy of the edited manuscript for review. Original artwork is returned only on request.

FEATURES are timely articles of interest to transportation professionals, including administrators, planners, researchers, and practitioners in government, academia, and industry. Articles are encouraged on innovations and state-of-the-art practices pertaining to transportation research and development in all modes (highways and bridges, public transit, aviation, rail, marine, and others, such as pipelines, bicycles, pedestrians, etc.) and in all subject areas (planning and administration, design, materials and construction, facility maintenance, traffic control, safety, security, logistics, geology, law, environmental concerns, energy, etc.). Manuscripts should be no longer than 3,000 words (12 double-spaced, typed pages). Authors also should provide charts or tables and high-quality photographic images with corresponding captions (see Submission Requirements). Prospective authors are encouraged to submit a summary or outline of a proposed article for preliminary review.

RESEARCH PAYS OFF highlights research projects, studies, demonstrations, and improved methods or processes that provide innovative, cost-effective solutions to important transportation-related problems in all modes, whether they pertain to improved transport of people and goods or provision of better facilities and equipment that permits such transport. Articles should describe cases in which the application of project findings has resulted in benefits to transportation agencies or to the public, or in which substantial benefits are expected. Articles (approximately 750 to 1,000 words) should delineate the problem, research, and benefits, and be accompanied by one or two illustrations that may improve a reader's understanding of the article.

NEWS BRIEFS are short (100- to 750-word) items of interest and usually are not attributed to an author. They may be either text or photographs or a combination of both. Line drawings, charts, or tables may be used where appropriate. Articles may be related to construction, administration, planning, design, operations, maintenance, research, legal matters, or applications of special interest. Articles involving brand names or names of manufacturers may be determined to be inappropriate; however, no endorsement by TRB is implied when such information appears. Foreign news articles should describe projects or methods that have universal instead of local application.

POINT OF VIEW is an occasional series of authored opinions on current transportation issues. Articles (1,000 to 2,000 words) may be submitted with appropriate, high-quality illustrations, and are subject to review and editing.

BOOKSHELF announces publications in the transportation field. Abstracts (100 to 200 words) should include title, author, publisher, address at which publication may be obtained, number of pages, price, and ISBN. Publishers are invited to submit copies of new publications for announcement.

LETTERS provide readers with the opportunity to comment on the information and views expressed in published articles, TRB activities, or transportation matters in general. All letters must be signed and contain constructive comments. Letters may be edited for style and space considerations.

SUBMISSION REQUIREMENTS: Manuscripts submitted for possible publication in *TR News* and any correspondence on editorial matters should be sent to the *TR News* Editor, Publications Office, Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001, telephone 202-334-2986, or e-mail lcamarda@nas.edu.

- ◆ All manuscripts should be supplied in 12-point type, double-spaced, in Microsoft Word, on a CD or as an e-mail attachment.
- ◆ Submit original artwork if possible. Glossy, high-quality black-and-white photographs, color photographs, and slides are acceptable. Digital continuous-tone images must be submitted as TIFF or JPEG files and must be at least 3 in. by 5 in. with a resolution of 300 dpi. A caption should be supplied for each graphic element.
- ◆ Use the units of measurement from the research described and provide conversions in parentheses, as appropriate. The International System of Units (SI), the updated version of the metric system, is preferred. In the text, the SI units should be followed, when appropriate, by the U.S. customary equivalent units in parentheses. In figures and tables, the base unit conversions should be provided in a footnote.

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