TR NEWS
March–April 2020
NUMBER 326

A Century of Progress Foundation for the Future

PLUS

Can Research Processes Keep Up?

TRB Committees Through the Years

MaaS Study Mission

100 YEARS MOVING IDEAS: ADVANCING SOCIETY

The National Academies of
SCIENCES • ENGINEERING • MEDICINE
TRB
TRANSPORTATION RESEARCH BOARD

The National Academies of
SCIENCES • ENGINEERING • MEDICINE

The **National Academy of Sciences** was established in 1863 by an Act of Congress, signed by President Lincoln, as a private, nongovernmental institution to advise the nation on issues related to science and technology. Members are elected by their peers for outstanding contributions to research. Dr. Marcia McNutt is president.

The **National Academy of Engineering** was established in 1964 under the charter of the National Academy of Sciences to bring the practices of engineering to advising the nation. Members are elected by their peers for extraordinary contributions to engineering. Dr. John L. Anderson is president.

The **National Academy of Medicine** (formerly the Institute of Medicine) was established in 1970 under the charter of the National Academy of Sciences to advise the nation on medical and health issues. Members are elected by their peers for distinguished contributions to medicine and health. Dr. Victor J. Dzau is president.

The three Academies work together as the National Academies of Sciences, Engineering, and Medicine to provide independent, objective analysis and advice to the nation and conduct other activities to solve complex problems and inform public policy decisions. The National Academies also encourage education and research, recognize outstanding contributions to knowledge, and increase public understanding in matters of science, engineering, and medicine.

Learn more about the National Academies of Sciences, Engineering, and Medicine at **www.nationalacademies.org**.

The **Transportation Research Board** is one of seven major programs of the National Academies of Sciences, Engineering, and Medicine. The mission of the Transportation Research Board is to increase the benefits that transportation contributes to society by providing leadership in transportation innovation and progress through research and information exchange, conducted within a setting that is objective, interdisciplinary, and multimodal. The Board's varied activities annually engage about 7,000 engineers, scientists, and other transportation researchers and practitioners from the public and private sectors and academia, all of whom contribute their expertise in the public interest. The program is supported by state transportation departments, federal agencies including the component administrations of the U.S. Department of Transportation, and other organizations and individuals interested in the development of transportation.

Learn more about the Transportation Research Board at **www.TRB.org.**

TRB

TR NEWS
Number 326 / March–April 2020

COVER This issue features photo highlights from TRB's 99th Annual Meeting in Washington, D.C., in January 2020. (Photo: Risdon Photography)

Coming Next Issue

The May–June 2020 issue of *TR News* is a special edition illuminating the many hidden aspects of tunnels as well as the benefits of tunnel technology to modern transportation systems. Articles highlight the contribution of tunnels to the economy and how transportation operators use the best technology to keep tunnels efficient and safe.

Photo courtesy Steve Ernst and Jeff Western

Alaskan Way Tunnel, the world's largest bored highway tunnel.

Also in This Issue:

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.

***TR News* is produced by Transportation Research Board Publications Staff**
Eileen P. Delaney, Director of Publications
Lea Camarda, Editor
Cassandra Franklin-Barbajosa, Editor
Jennifer G. Correro, Assistant Editor

TR News (ISSN 0738-6826) is issued bimonthly by the Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001. Internet address: www.TRB.org.

Editorial Correspondence: By mail to the Publications Office, Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001, by telephone 202-334-2986, by fax 202-334-3495, or by e-mail lcamarda@nas.edu.

Subscriptions: North America: 1 year $75; single issue $19. Overseas: 1 year $100; single issue $19 plus shipping. Inquiries or communications concerning new subscriptions, subscription problems, or single-copy sales should be addressed to the Business Office at the address below, or telephone 202-334-3216, fax 202-334-2519. Periodicals postage paid at Washington, D.C.

Postmaster: Send changes of address to *TR News*, Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001.

Printed in the United States of America.

A Century of Progress
Foundation for the Future

The Centennial celebration kicked off at the Transportation Research Board (TRB) 99th Annual Meeting. More than 14,000 researchers, policy makers, administrators, students, and transportation professionals gathered January 12–16, 2020, at the Walter E. Washington Convention Center in Washington, D.C., for more than 5,000 presentations in nearly 800 sessions and workshops, committee meetings, networking events, award presentations, and exhibits.

Among the meeting highlights was the release of TRB's Centennial book, *The Transportation Research Board, 1920–2020: Everyone Interested Is Invited,* by Sarah Jo Peterson, and the Chair's Luncheon address from U.S. Transportation Secretary Elaine L. Chao. More than 25 sessions and workshops focused on the meeting's theme, "A Century of Progress: Foundation for the Future." Peterson delivered two special lectures: the 2020 Thomas B. Deen Distinguished Lecture, "TRB's Technical Activities Committees: The Significance of Their History," as well as a Chair's Luncheon talk on TRB's history and the role of its sponsors.

Details and highlights appear on the following pages.

Annual Meeting photographs by Risdon Photography.

1 In honor of TRB's 100th anniversary, attendees gathered for a commemorative group photo on the first day of the 2020 Annual Meeting—and for some photos of their own.

2 TRB history book author Sarah Jo Peterson delivered the Centennial address at the Chair's Luncheon, Wednesday, January 15.

3 Chair's Luncheon keynote speaker U.S. Transportation Secretary Elaine L. Chao addressed transportation innovation.

Intersections

1 The Technical Activities Council oversees the organization and activities of TRB's standing committees.

2 Joshua Burroughs, University of Hawai'i, Manoa, shares research on transportation infrastructure resilience impacts in coastal areas caused by sea-level rise and climate change.

3 Rebekah Straub Anderson, Travel Survey Methods Committee chair, was one of the many TRB volunteer leaders assisting Annual Meeting newcomers at the New Attendee Orientation.

4 Colossal letters mark the entrance to TRB's 2020 Annual Meeting.

5 Candace Blair Cronin, ICF, asks a question of panelists at a session on FHWA Leadership in Innovation.

6 Thirty students from 16 schools participated in the TRB Minority Student Fellows Program, with research backgrounds ranging from aviation to planning to maritime transportation.

1 2020 TRB Technical Activities Council: (*front row, left to right*) C. James Kruse, Michael Griffith, Nikola Ivanov, TAC Chair Hyun-A Park, Richard Bornhorst, Pamela Keidel-Adams, Joe Schofer, (*back row, left to right*) Libby Rushley, Mark Reno, Fred Wagner, George Avery Grimes, William (Steve) Varnedoe, Brendon Hemily, Dave Ballard, Technical Activities Division Director Ann Brach, and Katie Zimmerman.

9 An all-female panel of state transportation agency leaders explores Equity's Role in Transportation Decision-Making: (*left to right*) Stephanie Pollack, Massachusetts DOT; Jennifer Cohan, Delaware DOT; Leslie Richards, Southeastern Pennsylvania Transportation Authority; Julie Lorenz, Kansas DOT; Diane Gutierrez-Scaccetti, New Jersey DOT; Victoria Sheehan, New Hampshire DOT; and Shoshana Lew, Colorado DOT.

Sessions & Workshops

1 Lisa Kenney, Buffalo–Niagara Regional Transportation Council, leads a team imagining scenarios for regional transportation planning to accommodate demographic change at the Strategic War Games workshop.

2 YuYu Zhang, University of South Florida, discusses planning and implementation issues at a two-part workshop on urban air mobility.

3 Leslie Wright, FHWA, asks an audience question at a workshop on 2050 Transportation Workforce Transformation Challenges.

4 Derrick Dasenbrock, Minnesota DOT, presides over a session on the Impact of the Mischaracterization of Rock on Construction Projects.

5 Adam Cohen, University of California, Berkeley, moderates a panel discussion on urban air mobility at the two-part workshop.

6 Diana Nomura, University of Hawai'i, Manoa, examines traffic problems at popular rural tourist attractions at a session on low-volume roads.

7 Leila Hajibabai, North Carolina State University, leads the 3-Minute Thesis Competition workshop on effective research communication.

8 Mark Reno (*left*) and Thomas Kazmierowski (*right*) recognize Colette Holt (*center*) as a featured speaker at the 16th Annual Dialogue with Leaders in the Design and Construction of Transportation Facilities.

Sessions & Workshops

(continued)

1 Omar Smadi, Iowa State University, presents lessons learned from the Roadway Information Database at a session on the implementation of the Second Strategic Highway Research Program databases.

2 KeAnna Dakwa, Tennessee State University, shares her analysis of traffic circles as they pertain to crash severity.

3 Hilary Nixon, San Jose State University, discusses the research center perspective on Promoting Your Research: Success Stories from Academia, State DOTs, and Journals.

4 (*Left to right:*) Kendis Paris, Truckers Against Trafficking; Keith Slotter, Jet Blue; and Kristen Joyner, Southwest Transit Association, speak on Combating Human Trafficking in the Transportation Sector.

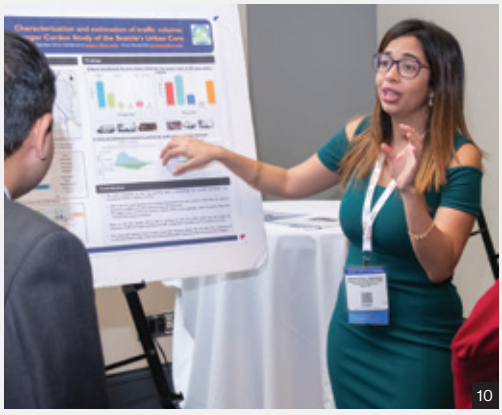
5 Benjamin Arras, University of Texas, El Paso, presents research on quantifying early-age concrete mechanical properties and curing conditions utilizing an automated system.

6 Stacey Kulesza, Kansas State University, addresses the corrosion potential of aggregate backfill in retaining walls at a session on Young Geotechnical Professionals in Transportation.

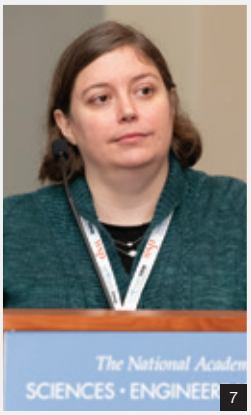
7 Brandon-Dean Morris, Transportation Technology Center, Inc., explores Current and Emerging Uses of Drones for Infrastructure Monitoring and Equipment Maintenance.

8 Cam'Ron McKinney, Tennessee State University, offers an analysis and model of ramp-related crashes in Tennessee.

9 Allison Irion, Argonne National Laboratory, shares research at a session on Strategic Challenges for Global Military Transportation and Supply Chains.



10 Gabriela del Carmen Giron Valderrama, University of Washington, discusses freight systems and marine transportation research.



10 Luca Montanari, FHWA, shares research on Surface Resistivity and Other Factors Related to Performance-Engineered Concrete Mixtures.

Sessions & Workshops

(continued)

1 Michael Nesbitt (*left*), FHWA, participates in a panel discussion on New Skills Needed to Meet Changing Demands in Transportation.

2 Denise Kearns, U.S. Environmental Protection Agency, presides over a Freight Day session on How E-Commerce Is Disrupting Supply Chains.

3 Jagannath Mallela (*left*), WSP, and Debra Brisk, DRB Consulting, address Building a Foundation for the Future Through Innovative Construction Research.

4 At the Six-Minute Pitch: A Transportation Startup Challenge, a panel of judges, including mobility strategist W. Celeste Davis (*center*), rated innovative transportation-related business ideas.

Other session speakers included the following:

5 Toks Omishakin, Caltrans, on State DOT CEO Roundtable: Toward Zero Deaths;

6 Laetitia Dablanc, Université Gustave Eiffel, on Sustainable and Efficient Solutions for Last-Mile Distribution;

7 Stacey Diefenderfer, Virginia Transportation Research Council, on High Recycled Asphalt Pavement Contents in Asphalt Mixtures; and

8 Julie Lorenz, Kansas DOT, on State DOT CEO Roundtable: Making the Right Investment.

9 (*Left to right:*) Vincent Valdes, FTA; Federal Transit Administrator K. Jane Williams; Tina Quigley, Virgin Trains USA; and Gary Thomas, Dallas Area Rapid Transit, at a session on Public Transit Innovation.

Sessions & Workshops

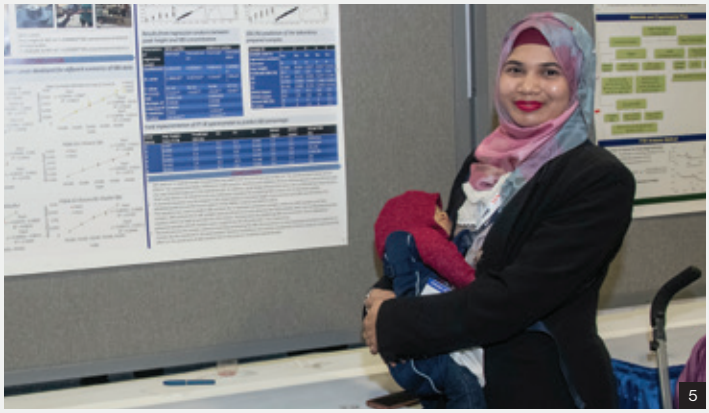
(continued)

1 Mara Campbell delivers a presentation on performance measurement in decision-making at a session on Measuring Performance Across Transportation Modes.

2 Avin Sharma, Port of Los Angeles, leads a panel discussion on Port Automation.

3 Eric Chase, Pennsylvania State University, addresses Developments to Improve Unpaved Road Performance.

4 Birat Pandey (*left*), FHWA, and Howard Slavin, Caliper Corporation, discuss National Freight Research, Methods, and Tools to Understand Freight Transportation.



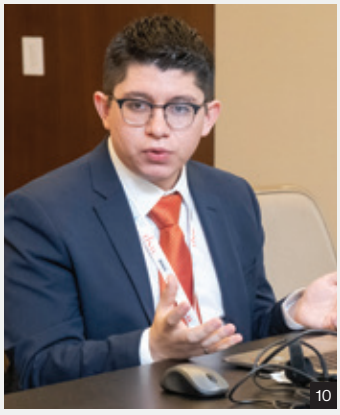
5 Roksana Hossain, Louisiana Polytechnic University, shares research on Asphalt Binders: Rejuvenation, Nonspecification Testing, and Investigations.

6 Alexander Herrgott, Federal Permitting Improvement Steering Council, delivers a presentation on Infrastructure Policy in 2020 and Beyond.

7 Ambria Vasquez, California State University, Los Angeles, presents research on Design Considerations of Diverging Diamond Interchanges in an Urban Setting.

8 Henry Chia, Jackson State University, conducted a failure analysis of an instrumented highway slope on Yazoo clay, a clay geologic formation in Alabama, Louisiana, and Mississippi.

9 Elise Miller-Hooks, George Mason University, explores Building Resilient Ships and Seaports.



Committees

1 Libby Rushley, Planning and Environment Group Chair, meets with fellow Technical Activities Council members.

2 Paul Leiby guides a meeting of the Transportation Energy Committee.

3 Rebecca McDaniel chairs the Asphalt Materials Section.

4 Julian Griffee delivers a presentation to the Emerging and Innovative Public Transport and Technologies Committee.

5 Angelica Torres shares her research at a meeting of the Non-Binder Components of Asphalt Mixtures Committee.

6 Alison Conway is a member of the Young Members Council, which focuses on activities to serve young members of TRB.

7 Rosemarie Spano *(center)*, Bureau of Land Management, participates in a meeting of the Transportation Needs of National Parks and Public Lands Committee.

8 Julie Dunbar guides the Transportation Planning Applications Committee through its meeting agenda.

9 Deb Mishra takes part in Aggregates Committee meeting deliberations.

10 Emiliano Ruiz offers research findings at a meeting of the Aviation Security and Emergency Management Committee.

Committees
(continued)

Among those who accepted Blue Ribbon Awards on behalf of TRB standing committees were:

1 William (Bill) Eisele,

2 Diana Long and Victoria Beale, and

3 Jeffrey Shaw and Hermanus Steyn.


1


2


3

Committees Awarded for Best Practices

The best practices of outstanding Technical Activities committees were honored with Blue Ribbon Awards at the Annual Meeting:

- *Identifying and Advancing Ideas for Research:* Urban Freight Transportation Committee, chaired by Bill Eisele;
- *Attracting and Preparing the Next Generation of Professionals and Scholars in TRB:* Operations and Preservation Young Members Subcommittee, cochaired by Leila Hajibabai and Chieh (Ross) Wang;
- *Moving Research Ideas into Transportation Practice:* Geometric Design Committee, chaired by Hermanus Steyn, and Operational Effects of Geometrics Committee, chaired by Jeffrey Shaw; and
- *Contributing to Improving the Management and Operation of TRB Committees:* Transportation Education and Training Committee, cochaired by Victoria Beale and Diana Long.


1


2

1 Jamille Robbins engages in a group discussion with the Public Involvement in Transportation Committee.

2 Chunfu Xin shares research announcements with the Asphalt Binders Committee.

TRB Selects Emeritus Members

In recognition of their long-term contributions and exceptional service to TRB's standing committees, the following individuals received emeritus membership at the 2020 Annual Meeting:

- Haitham Al-Deek, Freeway Operations Committee;
- Paul J. Carlson, Signing and Marking Materials Committee;
- Wiley D. Cunagin, Highway Traffic Monitoring Committee;
- Jerome F. Daleiden, Pavement Condition Evaluation Committee;
- Steven DeWitt, Project Delivery Committee;
- Rick Donnelly, Travel Forecasting Resources Committee;
- Dennis Hinebaugh, Bus Transit Systems Committee;
- Eric Kerness, Contract Law Committee;
- Robert McGennis, Asphalt Materials Section;
- Ronald D. Medlock, Fabrication and Inspection of Metal Structures Committee;
- Louay Mohammad, Surface Requirements of Asphalt Mixtures Committee; and
- Steven E. Shladover, Vehicle–Highway Automation Committee.

7 Cecilia Feeley (*right*), Rutgers University, received the William W. Millar Award for best paper in the field of public transportation. She is joined by Millar, past president of the American Public Transportation Association and namesake of the award.

8 Glenn Havinoviski, Iteris; Tammy E. Trimble, Virginia Tech Transportation Institute; and Richard Bishop, Bishop Consulting, were among the recipients of the John C. Vance Award.

9 The K. B. Woods Award was presented to Hubo Cai and Mark D. Bowman, Purdue University, for their paper on an ontology-based knowledge management system for digital highway construction inspection. Not pictured: Xin Xu, Chenxi Yuan, Yuxi Zhang, and Dulcy M. Abraham.

10 The Charley V. Wootan Award honoring the best paper in policy and organization went to Marianne J. W. A. Vanderschuren, Sekadi R. Phayane, and Alison Gwynne-Evans, University of Cape Town, South Africa.

Paper Awards

The Fred Burggraf Award is presented to researchers under age 35. The following recipients are shown left to right.

1 Keren Xu, Karthik Chowdary Pakalapati, and Jorge Rueda-Benavides, Auburn University, received the Burggraf Award for best design and construction paper.

2 Mohammadreza Khajeh Hosseini, Yalda Rahmati, and Alireza Talebpour, Texas A&M University, received the Burggraf Award for best operations and preservation paper. Not pictured: Benjamin Swain and Christopher Nelson.

3 Carole Turley Voulgaris, California Polytechnic State University, and Jill Elizabeth Shinn, KPFF Consulting Engineers, received the Burggraf Award for best public transportation paper.

4 Angshuman Guin, Georgia Institute of Technology; Sung Jun Park, Jacobs Engineering; James Anderson, AECOM; and Michael Hunter, Georgia Tech, received the D. Grant Mickle Award for their paper on operating performance of diverging diamond interchanges.

5 The Patricia F. Waller Award honors an outstanding paper in the field of safety and systems users. Recipients are Bo Lan, Libby Thomas, Wesley J. Kumfer, and Laura S. Sandt, Highway Safety Research Center, University of North Carolina.

6 The Pyke Johnson Award for best paper in planning and the environment was awarded to Miriam Pinski, Martin Wachs, Evelyn Blumenberg, and Andrew Schouten, University of California, Los Angeles.

Major Awards

1 Sarah Jo Peterson, Centennial speaker, engaged the audience in a participation activity.

2 U.S. Transportation Secretary Elaine L. Chao delivered the Chair's Luncheon address.

3 Emily Moylan (*third from left*) accepted the Roy W. Crum Award on behalf of Sue McNeil, Professor of Civil and Environmental Engineering and Public Policy and Administration, University of Delaware. The award recognizes outstanding leadership in transportation research or research administration. Presenting the award were (*left to right*) Carlos M. Braceras, 2019 TRB Executive Committee Vice Chair; Victoria A. Arroyo, 2019 Executive Committee Chair; and Neil Pedersen, TRB Executive Director.

4 For his consistent support for TRB and research and innovation during his career at both FHWA and the American Association of State Highway and Transportation Officials, Frederick G. (Bud) Wright (*second from right*) was the 2019 recipient of the W.N. Carey, Jr., Distinguished Service Award.

5 Robert H. Prince, HNTB Corporation, received the Sharon D. Banks Award for innovative and successful leadership in people-oriented initiatives in transportation.

6 Peterson (*center*) delivered the 2020 Thomas B. Deen Distinguished Lecture, named after the former TRB Executive Director (*right*).

7 Carlos Braceras announces awardees at the Chair's Luncheon.


1

2


3


4


5

5 Prince was recognized for his impact on the people he has served and for his dedication in supporting and mentoring the next generation of transit leaders. The biennial award was established in the memory of Sharon D. Banks, former General Manager of AC Transit in Oakland, California, and past TRB Executive Committee Chair.


6


7

New Leaders Guide Executive Committee

Carlos M. Braceras, Executive Director of the Utah Department of Transportation (DOT), is 2020 Chair of the TRB Executive Committee. In 2013, he was appointed to lead Utah DOT's more than 1,600 employees and the design, construction, and maintenance of the state's 6,000-mile system of roads and highways. He had served as deputy director of the agency since 2001. Braceras recently guided the completion of two of the largest highway projects in Utah history: the Utah County I-15 Corridor Expansion and the first phase of the Mountain View Corridor in west Salt Lake County.

Braceras is chair of the American Association of State Highway and Transportation Officials (AASHTO) Design Subcommittee and AASHTO past president, chair of the Center for Environmental Excellence Advisory Board, and past president of the Western Association of State Highway and Transportation Officials. He received bachelor's degrees in geology from the University of Vermont and in civil engineering from the University of Utah.

The 2020 TRB Executive Committee Vice Chair is Susan Shaheen, Civil and Environmental Engineering Professor at the University of California (UC), Berkeley, and codirector of the Transportation Sustainability Research Center, Institute of Transportation Studies, Berkeley. An expert and pioneer in future mobility strategies, Shaheen was among the first to observe, research, and write about changing dynamics in shared mobility and the rise of automated vehicles.

The first Honda Distinguished Scholar in Transportation at the Institute of Transportation Studies at UC Davis, Shaheen also served as the Policy and Behavioral Research Program Leader at California Partners for Advanced Transit and Highways and as a special assistant to the Director's Office of the California Department of Transportation from 2001 to 2004. She has a Ph.D. in ecology from UC Davis and a master's degree in public policy analysis from the University of Rochester, New York.

Marie Therese Dominguez and Mike Goodchild are new members of the Executive Committee. Reappointed members include Nathaniel Ford, Patrick McKenna, and James Tien.

Executive Committee

Each year the TRB Executive Committee chooses a topic for deeper investigation to address in a policy session. The 2020 policy session topic was artificial intelligence in transportation, with a panel of experts that included (*left to right*):

1 Prasanna Balaprakash, Argonne National Laboratory;

2 Richard Davies, Oak Ridge National Laboratories; and

3 Cathy Wu, Massachusetts Institute of Technology.


1


2


3

Executive Committee

(continued)

1 Carlos M. Braceras is the 2019 Executive Committee Vice Chair.

2 2019 Chair Victoria A. Arroyo guides the Executive Committee through its meeting agenda.

3 Executive Director Neil Pedersen presents a progress report on TRB's strategic initiatives.

Also participating in Executive Committee deliberations were

4 Diane Gutierrez-Scaccetti, New Jersey DOT Commissioner;

5 FHWA Administrator Nicole R. Nason;

6 Nathaniel P. Ford, Sr., Jacksonville Transportation Authority CEO;

7 Ashby Johnson, Executive Director, Capital Area Metropolitan Planning Organization;

8 Shana V. Baker, FHWA;

9 Michael Berube, U.S. Department of Energy;

10 Quintin Kendall, FRA;

11 Maryam Allahyar, U.S. DOT Office of Research, Development, and Technology;

12 Marie Therese Dominguez, New York State DOT Commissioner;

13 Rebecca Cointin, FAA; and

14 Todd Ripley, U.S. Maritime Administration.


1


2


3


4


5


6

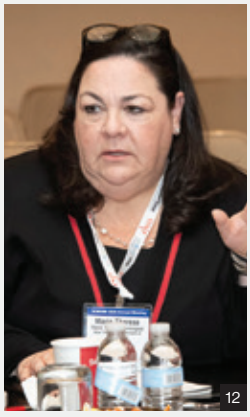

7


8


9


10


11


12


13


14

CAN OUR RESEARCH PROCESSES KEEP UP?

Photo by Trevor Wrayton, Virginia DOT

MARK R. NORMAN

The author is Resident Scholar, Transportation Research Board, National Academies of Sciences, Engineering, and Medicine, Washington, D.C.

Above: An automated vehicle demonstration hosted by Virginia DOT in 2015. In the past 5 years, vehicle automation has advanced and further become a part of the transportation landscape.

The private sector is investing billions of dollars in research to deploy a series of transformational technologies in transportation. Just as these companies and technologies are disrupting transportation, they may also disrupt the research processes traditionally followed by the public sector and academia—in other words, "getting it first versus getting it right."

Although these two objectives are not always the same, they also are not mutually exclusive. Traditional research processes have ensured quality science over many years; at the same time, however, research results are often not available until after the need has passed and policymakers have made their decisions and moved on.

In an era of rapidly evolving transformational technologies, can our research projects and processes quickly provide needed answers while still protecting research credibility—and if so, how? That question was the focus of a series of discussion groups hosted by the Transportation Research Board (TRB) Standing Committee on the Conduct of Research. Following that series, the National Academies/TRB Forum on Preparing for Automated Vehicles and Shared Mobility sponsored a workshop on the topic in May 2019.

Workshop and discussion group participants made it clear that automated vehicles, shared mobility, and other transformational technologies in transportation provide a unique opportunity to significantly advance societal goals. Success is far from assured, however, with more questions than answers arising. Research is the key but time is short; these technologies and deployments are advancing and changing rapidly.

It is critical, therefore, to look at the available options that enable research projects and processes to provide needed answers more quickly while protecting the credibility of the research. This article explores these options, as well as

The National Academies/TRB Forum on Preparing for Automated Vehicles and Shared Mobility has hosted many meetings, most recently in February 2020.

the integral role of collaboration among public, private, and academic sectors—and how TRB itself can provide more opportunities for collaboration through convening activities such as the Forum, conferences, standing committees, and research panels.

Ensuring Quality Science

Workshop and discussion group participants emphasized that the "need for speed" is situational. For each research question or situation, participants listed the following considerations to help researchers achieve the right balance:

- What is the ultimate objective of this research?
- What is the urgency?
- What defines acceptable risk?
- How much evidence is needed to move forward?
- What are the barriers?
- Is it possible to provide transparency and to balance stakeholder influence?
- Is it possible to ensure that the research results are objective without necessarily being neutral?

In addition, traditional research processes too often rely on one set period for most projects. The above questions can help researchers determine a targeted timeline appropriate for the research in question. Once they determine the timeline, they can design and implement an applicable research process.

New Approaches to Research Processes

The typical life cycle for a research project is shown in Figure 1 (below). The following list offers options, presented by participants of the workshop and discussion, to produce quality research results in a timely fashion.

GENERAL RESEARCH PROGRAM MANAGEMENT

- Continuously build and nurture leadership support.
- Look for, and take advantage of, opportunities to reduce administrative burdens.
- Test rapid response models used by others; for example, the National Science Foundation (*1*).

IDENTIFICATION OF RESEARCH PRIORITIES

- Develop and rely on dynamic research roadmaps to establish priorities and to generate individual problem statements.
- Rely on scenario planning to consider emerging needs.[1]
- Employ continuous calls for proposals.

[1] Scenario planning "provides a framework for developing a shared vision for the future by analyzing various forces (e.g., health, transportation, livability, economic, environmental, land use), that affect communities." See the Federal Highway Administration's *Scenario Planning Guidebook:* www.fhwa.dot.gov/planning/scenario_and_visualization/scenario_planning/scenario_planning_guidebook_2011/ch01.cfm.

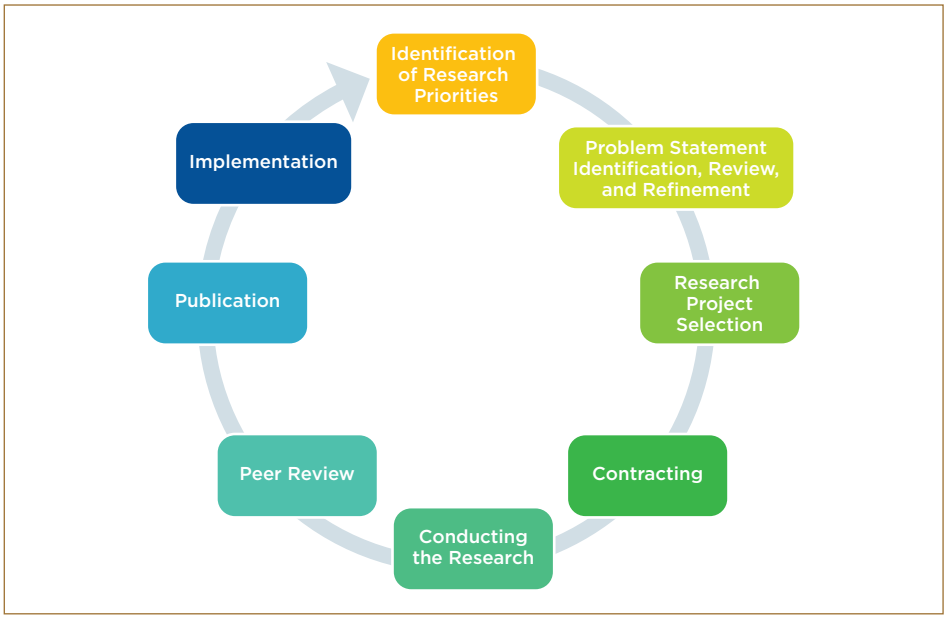


FIGURE 1 Typical research life cycle.

- Seek approaches that will result in a more continuous and visible process, such as a research needs dashboard.
- Seek input from stakeholders and the public to understand what is needed in the real world.
- Prepare meta-analyses of completed research on a policy topic, targeted to specific audiences.

PROBLEM STATEMENT IDENTIFICATION, REVIEW, AND REFINEMENT

- Pursue strategic-level research, focusing on broad research program areas instead of discrete projects.
- Clearly define the research objective at the beginning.
- Break research questions into smaller pieces or phases.

RESEARCH PROJECT SELECTION

- Prioritize and select discrete projects from broader program areas or roadmaps.
- Balance larger, complex projects with smaller, shorter projects.

CONTRACTING

- Prepare requests for proposals (RFPs) that focus on outcomes instead of prescribing specific research processes.
- Consider relying on requests for qualifications rather than RFPs.
- Prequalify contractors in defined subject areas.
- Employ indefinite delivery–indefinite quantity contracts.
- Award projects with shorter phases.

RESEARCH EFFORT

- Accomplish tasks in parallel rather than in a series and bring them together at the end.
- Enhance the flexibility of researchers and staff to achieve desired outcomes.
- Use interim reporting to determine if directional changes are needed.
- Enforce deadlines.
- Avoid scope creep.

PEER REVIEW

- Create and maintain a standing pool or pools of peer reviewers.
- Peer review phases of the research as they are completed, rather than waiting until the end of the project to review all phases at once.

PUBLICATION

- Release phases of the research as they are completed.
- Release interim results or prepublication findings, or both, before final editing.
- Work closely with public affairs and communications experts to package the findings for specific audiences.

IMPLEMENTATION

- Include technology transfer as an integral part of the research project life cycle.
- Leverage scheduled field tests and demonstrations.
- Use pilot projects to test "laboratory" results.
- Identify and involve a community of stakeholders and partners to deploy the results.

Fostering Collaboration Among Sectors

Workshop and discussion participants repeatedly stressed that collaboration among the public, private, and academic research sectors is necessary to meet the twin objectives of providing answers quickly while protecting research credibility. All parties should strengthen research partnerships among sectors, supplemented with significant input from the end user—the public.

TRB Standing Committee on the Conduct of Research

The committee's scope is to increase the quality and effectiveness of research by encouraging better planning, management, and operational practices in transportation research organizations and to assist TRB in stimulating research and serving as a national clearinghouse for research activities. In 2020, this committee will merge with the Standing Committee on Technology Transfer as part of the Board's committee restructuring and will be renamed the Standing Committee on Research and Innovation Management. For more, see http://sites.google.com/site/conductofresearchcommittee.

National Academies–TRB Forum on Preparing for Automated Vehicles and Shared Mobility

The objective of this Forum is to bring together public, private, and research organizational partners to share perspectives on the critical issues surrounding the deployment of automated vehicles and shared mobility. An emphasis is on the discussion, identification, and facilitation of fact-based research needed to deploy these technologies in a manner and timeframe that informs policy to best meet long-term goals. These goals include increasing safety, reducing congestion, enhancing accessibility, increasing environmental and energy sustainability, and encouraging economic development and equity. For more, see https://trb.org/AVSMForum.

Photo: Arizona DOT

Accelerated bridge construction techniques in use on I-40 in Meteor City, Arizona. Transportation agencies must work from shared long-term goals—reducing traffic and increasing safety—when coordinating research for new technologies.

Common goals must be identified, such as improving safety and alleviating congestion. Research officers must also involve the public and stakeholders in an advisory role early on to help define the purpose of the research. Advisory groups and other nontraditional partnerships can come together frequently to identify collaborative research goals more quickly, facilitated by such tools as pooled fund studies and shared research roadmaps. An important final step is to have a community of stakeholders and partners ready to deploy the research results.

Industry, the public sector, and academia all can work with universities to attract the best and brightest into the transportation profession. Within academia, competition among researchers—which can present a barrier to sharing early results—should be reduced. Research sponsors can encourage academics and public-sector researchers to share their results as widely as possible. At the same time, confidentiality agreements can cover data sharing itself.

It largely is a misperception that there are high levels of transportation research duplication. In transportation, there rarely are enough resources to validate earlier research. Instead, research officers should pursue complementary efforts to validate and fill gaps.

Communicating accurate research results with the media and public is incredibly important. Researchers should work closely with public affairs and communications experts to package and target research results to specific audiences and should stay involved in these efforts to make sure the messages are accurate.

State departments of transportation (DOTs) also can streamline their own processes and foster collaboration between the research office and other divisions. Research officers should keep other DOT divisions informed of ongoing and completed research and should work with other DOT divisions to identify and address emerging issues continually. The research office also can prepare other DOT divisions for implementation of research results. All state DOT research offices have a responsibility for policy research, though smaller states may need to focus more on applied research.

What Can TRB Do?

TRB is at the forefront of transportation research and can test some of these new approaches to traditional research processes. For example, the Board will continue to conduct and disseminate research via National Cooperative Highway Research Program Project 20-102, "Impacts of Connected Vehicles and Automated Vehicles on State and Local Transportation Agencies," which deploys prequalified research teams, a research roadmap, and prepublication dissemination of some results.

A strategic research program dedicated to transformational technologies in transportation may be helpful, and TRB can consider what options exist to pursue such a program. More dedicated funding is likely needed to address these issues, especially public policy issues.

TRB could provide a clearinghouse of information linked to a research roadmap for automated vehicles and shared mobility. TRB volunteers and staff also can solicit input from the Conduct of Research Committee on additional steps to address these issues.

REFERENCE

1. National Science Foundation. Grants for Rapid Response Research (RAPID). Jan. 1, 2009. www.nsf.gov/pubs/policydocs/pappguide/nsf09_1/gpg_2.jsp#IID1.

Photo: Washington State DOT

Washington State DOT used a drone to inspect and capture 3-D images of a rockslide on SR-503 near Woodland. The images then were used to develop a permanent repair.

Centennial Papers

Tracing TRB's History Through Its Standing Committees

KAREN FEBEY

The author is Senior Report Review Officer, Transportation Research Board, National Academies of Sciences, Engineering, and Medicine, Washington, D.C.

Above: The Emergency Evacuation Committee meets at the 2020 TRB Annual Meeting in Washington, D.C., in January.

The standing committees of the Transportation Research Board's (TRB's) Technical Activities Division are communities of individuals who share an interest and expertise in transportation. As part of TRB's Centennial celebration, all 200-plus standing committees were invited to submit a Centennial Paper, which showcases each standing committee's evolution, past accomplishments, and contributions to the transportation field.[1]

This article highlights some of the accomplishments and varied missions of six of the submitted Centennial Papers.

Standing Committee on Emergency Evacuations

The Standing Committee on Emergency Evacuations seeks to increase the understanding of the technological, operational, and human dimensions of evacuations during emergencies and disasters. The committee addresses both vehicle-borne and pedestrian evacuations of all types, from rapid building exits to megaregional, multiple-day mass evacuations—including evacuation planning and the return of residents.

The group started as a subcommittee in January 2001 to raise the profile of the problems, needs, and research opportunities in the field of evacuation. Hurricane George in 1998 and Hurricane Floyd in 1999 provided an impetus for the subcommittee: the transportation-related issues with these evacuations revealed potential transportation disruptions that could put thousands of people—if not millions—at risk. By 2012, the subcommittee had been elevated to a task force and became a full committee in 2015 in the Transportation Systems Resilience section.

The Emergency Evacuations Committee is interested not only in the response phase—that is, the evacuation itself—but also in preparation, mitigation, recovery, all modes, and all causes. This includes

[1] More than 75 committees contributed papers, which now are featured on TRB's Centennial website: https://trbcentennial.nationalacademies.org.

evacuations from planned special events, not exclusively disasters. Committee members have directly affected evacuation practice through the following work:

- Updated hurricane evacuation plans across the country.
- Revised the way nuclear power plant emergencies are analyzed, planned, and managed.
- Planned for carless and special-needs evacuees.
- Generated techniques to model the generation and routing of evacuation travel.
- Developed tools used to simulate evacuation traffic processes.

In July 2018, the Emergency Evacuations Committee held its first midyear meeting, followed by a second meeting in October, hosted in conjunction with the Transportation Resilience Innovations Summit and Exchange conference.

At the 2019 TRB Annual Meeting, the committee led lectern and poster sessions on evacuation decision-making and behavior, improving emergency response with multimodal evacuations, issues in using data during emergency responses, pedestrian and facility evacuations and emergency response, and evacuation theory. In addition, members identified mass refugee migrations and evacuations as an under-studied area of concern and encouraged related research and reports.

The Emergency Evacuations Committee plans to continue fostering increased understanding of the technological, operational, and human dimensions of evacuation during emergencies and disasters and to provide a forum to identify research needs, encourage and facilitate individual and joint research efforts, and share knowledge on evacuations.

Standing Committee on Aviation Economics and Forecasting

Back in 1977, the Standing Committee on Aviation Economics and Forecasting began as the Committee on Aviation Forecasting—the second aviation-specific committee at TRB, comprised of representatives from the Federal Aviation Administration (FAA), airlines, manufacturers, academia, airport operators, and industry consultants.

To fulfill the need for an aviation committee that focused on a wider range of economic topics, the Task Force on the Economics of Air Transport was created in 1981. In 1984 it became a committee and then merged with the Aviation Forecasting Committee in 1986. A primary goal of the Aviation Economics and Forecasting Committee is to discuss and inform participants of the latest factors considered in the development of the FAA's annual forecast of aviation activity.

Today, the committee membership represents a broader swath of the aviation industry, including more academics and researchers as well as more participation from international members, students, and young people.

Over the years, the subjects discussed at Annual Meetings and other venues by the Aviation Economics and Forecasting Committee have addressed current events as well as issues with continuing implications for the aviation sector; for example, airline competition and consolidation, new entrant airlines, airport slot controls, airport capacity, federal taxes and fees, the organization and ownership of the air traffic control system, forecasting methodologies, data and techniques, and aircraft equipment issues.

Along with its Annual Meeting sessions, the Aviation Economics and Forecasting Committee worked with the Light Commercial and General Aviation Committee to organize a biannual Workshop on Future Aviation Activities for the FAA, which concluded in the early 2000s. This 2-day workshop informed the FAA's Annual Aerospace Forecast on growth and fleet size in the aviation industry. Discussions at these workshops also served as the basis for TRB Circulars and E-Circulars, which discussed the post-deregulation history of the aviation industry.

The Aviation Economics and Forecasting Committee also has participated in high-profile efforts to study specific aspects of the aviation industry via a series of TRB Special Reports on the U.S. airline industry, which responded to congressional requests for investigation of industry trends. Most recently, committee members contributed to the May–June 2018 issue of *TR News* on "40 Years of Transportation Deregulation," which included

Photo: Sharon Dowdy

Traffic congestion on I-75N through Butts County, Georgia, as coastal residents evacuate ahead of Tropical Storm Irma in 2017.

Photo: Lisbokt, Flickr

Aerial view of airport. Founded in the late 1970s, the Standing Committee on Aviation Economics and Forecasting represents a broad cross-section of the aviation industry.

retrospective views on deregulation and key issues facing the industry.

The committee plans to stay abreast of emerging issues and new uses of airspace, including unmanned aircraft systems, the growing commercial space launch industry, and other emerging technologies.

Standing Committee on Transit Capacity and Quality of Service

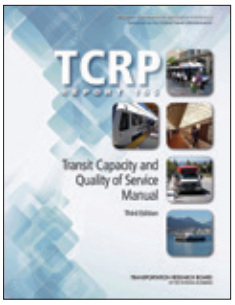
The Standing Committee on Transit Capacity and Quality of Service cuts across all urban public transportation modes and focuses on the areas of transit planning, operations, design, and management. The committee is concerned with relationships among physical and nonphysical factors affecting transit capacity and quality of service; techniques for measuring, reporting, and applying capacity and quality of service; and acceptable standards of service based on measurable characteristics. By identifying research needs and providing stewardship of TRB's *Transit Capacity and Quality of Service Manual* (TCQSM), as well as through workshops, webinars, Annual Meeting sessions, the committee supports the practitioner community in learning about and applying capacity and quality of service concepts and methods.

The origins of the Transit Capacity and Quality of Service Committee date back to 1998, when it began as a task force and the first edition of TCQSM was being prepared. Published in 1999, TCQSM was envisioned as the transit counterpart to the widely used *Highway Capacity Manual* (HCM), serving as a consolidated, authoritative source of transit capacity and quality of service concepts definitions, methods, and applications for planning, designing, and operating transit services and facilities.

The task force, and eventual committee, followed the model used since 1944 by the Highway Capacity and Quality of Service Committee, assembling a committee of practitioners, researchers, and educators to shepherd the development and evolution of HCM. This involved reviewing draft chapters, sponsoring user outreach and training, and finding sponsors for research problem statements to ensure HCM methods continued to represent the state of the practice.

A recent initiative of the Transit Capacity and Quality of Service Committee is investigating how TCQSM content will need to change to reflect the adoption of automated and connected vehicle technology by both public transit and private vehicles. The committee's initial work indicates that nearly every section of the manual will need to be updated to reflect the new and emerging needs to support these technologies.

The committee has a unique role in the Public Transportation Group—it cuts across modes (bus, paratransit, rail, and ferry) and functions (planning, operations, design, and management) and therefore provides a holistic view of moving large numbers of people within urban areas and providing effective transit coverage in suburban and rural areas. It also is one of the few TRB committees responsible for supporting a living document along with fulfilling its normal committee responsibilities. It does this by developing research problem statements, providing post-publication user support, educating potential and current users, and reviewing the content of new editions of TCQSM as they are developed.



For the third edition of the *Transit Capacity and Quality of Service Manual*, see www.trb.org/Main/Blurbs/169437.aspx.

The committee envisions its future work as continuing to identify and advocate for research needs that address issues of capacity and transit quality of service for all transit modes and areas of service. These research needs will evolve as demographic shifts and technology factors continue to affect the overall transportation industry. The committee also

The Sarbanes Transit Center in downtown Silver Spring, Maryland, is a hub for many public transit modes, from commuter rail and metrorail (shown) to local and regional buses.

plans to maximize the usage of TCQSM as a premier educational tool for university programs and professionals. Future activities will focus on these areas, and the committee looks forward to working with other TRB committees to sponsor Annual Meeting workshops and sessions and to identify and refine research topics.

Standing Committee on the Transportation Needs of National Parks and Public Lands

Established in 1998 as a task force, the Standing Committee on the Transportation Needs of National Parks and Public Lands became a full committee in 2006 and focuses on the role of transportation in providing access to and mobility within national parks and other public lands. Examples of public lands include those operated by the U.S. Forest Service; U.S. Fish and Wildlife Service; Bureau of Land Management; U.S. Army Corps of Engineers; Bureau of Reclamation; and state, county, and local parks. The committee provides a forum for transportation and land management agencies, tourism groups, universities, consultants, and public officials to share information on management issues regarding access, circulation, travel modes, safety, congestion, performance-based planning, asset management, operations, maintenance, and wayfinding on public lands.

The Transportation Needs of National Parks and Public Lands Committee is different from other TRB standing committees in that it has significant representation from federal land management agencies, as well as gateway communities and state and local parks, instead of being mainly comprised of representatives from state departments of transportation, consultants, and university researchers. This mix of members allows the committee to discuss cross-jurisdictional transportation challenges like transportation within and access to public lands, as well as multimodal opportunities like motorized and active transportation within parks.

Although the Transportation Needs of National Parks and Public Lands Committee has an active presence at the Annual Meeting, hosting podium sessions, poster presentations, and committee and subcommittee meetings, it has many other unique activities and programs. It hosts midyear meetings at various National Parks and public lands across the United States so that committee members can learn about transportation issues from local representatives both at the parks and in adjacent communities and can interact with those who live and work in the areas they visit.

National Park Service ranger Emily Zivot takes members of the Standing Committee on Transportation Needs of National Parks and Public Lands on a tour of Theodore Roosevelt Island in Washington, D.C., in 2014.

The committee also has been a key supporter of the development of young professionals through the Public Lands Transportation Fellows Program, managed by the Western Transportation Institute in cooperation with the U.S. Fish and Wildlife Service. Fellows attend the Annual Meeting, present research at a committee-sponsored poster session, and participate in other professional development activities with committee members. Fellows who complete their assignment are eligible for federal noncompetitive hiring status for 2 years after the completion of their fellowship, and this creates an avenue for young people to address transportation needs of federal lands.

In addition, the committee develops research ideas that are brought for consideration to the National Cooperative Highway Research Program (NCHRP) and the Transit Cooperative Research Program. Most recently, one of its research needs statements was chosen for funding through NCHRP Project 08-132, "Accessing America's Great Outdoors: Understanding Recreational Travel Patterns, Demand, and Future Investment Needs for Transportation Systems."

Standing Committee on Design and Rehabilitation of Asphalt Pavements

The Standing Committee on Design and Rehabilitation of Asphalt Pavements was established as the Committee on Flexible Pavement Design in 1939 and, after several reorganizations, took its current name in 2003. The committee's mission has always been to apply the outcomes of the American Association of State Highway Officials (now the American Association of State Highway and Transportation Officials, or AASHTO) Road Test and to advance the design, theory, and performance of flexible pavements, thus supporting the

implementation of improved methods for designing and predicting performance of flexible pavements.

Based on advancements in pavement monitoring technology and computing techniques, the Flexible Pavement Design Committee's focus shifted to the advancement of mechanistic–empirical (M-E) flexible pavement design, including factors that influence the physical behavior, service life, and economy of flexible pavements.

The Flexible Pavement Design Committee has taken an active role integrating asphalt pavement structural design, mixture design, and construction. The integration of asphalt structural and mixture design was initiated in the late 1980s as an outcome from the Long-Term Pavement Performance Program and the implementation of the Superpave™ asphalt mix design procedure initiated in the early 1990s.

Along with other TRB committees, the Flexible Pavement Design Committee supported and participated in workshops in the 1990s that led to the development of the *Mechanistic–Empirical Pavement Design Guide* (MEPDG). Recognizing the importance of integrating design, materials, and construction, the committee supports the implementation of MEPDG.

In the late 1990s, the Flexible Pavement Design Committee focused on knowledge transfer among retiring state transportation agency personnel and emerging professionals. Committee members identified ways to share their knowledge with these younger professionals and increase participation from those professionals in the committee, which continues today.

One emerging issue for the committee is M-E design, which became the official structural design approach of AASHTO in 2011 with the commercial release of AASHTOWare Pavement M-E software. Deployment of the new design methodology was the culmination of decades of research and development. Many state agencies are implementing M-E design by carrying out evaluation, local calibration, and validation. These efforts will continue for the foreseeable future, since the implementation of M-E design is an ongoing critical issue for asphalt pavement design and rehabilitation.

Another emerging issue for the Flexible Pavement Design Committee is the expansion of applications for porous asphalt pavements, which is becoming more widespread, as evidenced by its use in states like Georgia and countries like the Netherlands. Porous asphalt with air void levels approaching 20% has been used for stormwater management, improving wet weather safety and for reducing noise. New design techniques likely will enable the porous asphalt's unique properties to be captured in existing design software.

Archive Photo

The long-running activities of the Design and Rehabilitation of Asphalt Pavements Committee have focused on the findings of the AASHO Road Test, conducted in the late 1950s.

Standing Committee on Testing and Evaluation of Transportation Structures

The Standing Committee on Testing and Evaluation of Transportation Structures focuses on applying technologies to study in-service bridge behavior for the validation and improvement of design guidelines, as well as on safety inspections and evaluations for transportation structures. For more than 50 years, the committee has worked to bridge the gap between the state of the art and state of the practice through technology transfer and support of research in these areas.

This committee began in 1962 as the Field Testing of Bridges Subcommittee. It was one of six subcommittees formed under the Committee on Bridges, the first formal committee dedicated to the practice of bridge engineering within the Highway Research Board, now TRB. The Committee on Bridges and its subcommittees were reorganized in 1964 into a fully fledged standing committee.

The Testing and Evaluation of Transportation Structures Committee's primary activities include organizing lectern and poster sessions at both the Annual Meeting and at specialty bridge conferences. In addition, the Committee also holds workshops and produces state-of-the-practice documents on topics such as structural health monitoring (SHM) load testing of bridges and nondestructive evaluation (NDE). Ideally, these documents will become useful tools for bridge owners to encourage use of SHM and NDE for bridge evaluation and monitoring.

Additionally, committee members have been instrumental in initiating and

Photo: Risdon Photography

Sreeniva Alampalli guides discussion at a 2017 meeting of the Testing and Evaluation of Transportation Structures Committee.

leading structures materials technology conferences since the early 2000s, working with the Federal Highway Administration and the American Society for Nondestructive Testing. The biennial conference continues today and meets at different locations to encourage maximum participation from industry members and state DOTs. Similarly, committee members have been active with the biennial International Conference on Bridge Maintenance, Safety, and Management as well as American Society of Civil Engineers conferences, such as the annual Structures Congress. In August 2019, committee members worked with the International Society for Structural Health Monitoring of Intelligent Infrastructure to host its first-ever conference in the United States.

New strategies mean that tools for knowledge transfer must be prioritized.

Looking forward, the Testing and Evaluation of Transportation Structures Committee believes that one key issue related to studying in-service bridge behavior will be balancing the constraints of limited budgets and personnel resources with the need for improved methods for condition assessment and monitoring of transportation structures. New strategies for implementation of technologies for efficient and effective condition assessments mean that tools for knowledge transfer must be prioritized.

A broad array of committees has interest in NDE tools for highway infrastructure condition assessment and the field testing of bridges. Thus, the committee plans to continue developing strong relationships with these and other committees and organizations concerned with monitoring the in-service performance and safety of structures.

Driver Training for Advanced Driver Assistance Systems

Who Needs It, Who Wants It, and Will It Make a Difference?

Photo: State Farm

STEVE CASNER

The author is a research psychologist at the National Aeronautics and Space Administration Ames Research Center, Moffett Field, California.

Above: Studies of reverse driving crashes in cars equipped with backup cameras found that, instead of supplementing regular procedure of checking mirrors and looking over their shoulders, many drivers were using the cameras to trade one blind spot for another.

In 2008, 292 people were killed and another 18,000 injured when motorists attempted the most dangerous driving stunt permitted outside of a closed-course test track: backing up. Children under age five, who comprise 44% of all backup fatalities, were most likely to pay the price when things went wrong.

From the perspective of the engineer, an obvious contributor to these tragedies was that drivers could not see what was behind their vehicle. From the perspective of the engineer, the solution to the problem could not seem any clearer. First proposed by Buick in 1956, rearview cameras began to appear in 2001. After some delay, the National Highway Traffic Safety Administration issued its final rule requiring that all cars be outfitted with cameras by 2018.

With more and more camera-equipped cars rolling off the assembly line, the industry prepared for a dramatic decline in backup fatalities—but this didn't happen. In 2017, Jessica Cicchino, a researcher at the Insurance Institute for Highway Safety (IIHS), conducted a study that compared the safety records of cars with and without rearview cameras (*1*). Cicchino found that, overall, cars with cameras were 17% less likely to be involved in a police-reported backup crash. *Seventeen percent*—far from the hoped-for 100%.

With the entire perimeter of a vehicle now within view, what could possibly be going wrong? Another team of researchers at IIHS, led by David Kidd, already had identified one possible issue. In their observations of drivers using rearview cameras, Kidd's team found that, instead of using the camera to supplement their scans in the manner envisioned by engineers, many drivers were using the cameras as a *substitute* for a more complete scan. In other words, drivers simply looked at the rearview scene and proceeded if the rear looked clear. The traditional over-the-shoulder glances were now less frequent. What drivers seemed to miss is that the most common sort of backup crash happens when a child comes running from the *side* of the car. Kidd found that many drivers were using the cameras to trade one blind spot for different blind spots (*2–3*).

Blind Trust

Such encounters with rearview cameras are hardly the only example of how things can go wrong when drivers use the technologies now being deployed in many late-model vehicles. The newspaper headlines tell similar stories about other car automation systems: "Tesla's Autopilot keeps crashing into parked cars. Here's why;" "Don't blindly trust your car's collision avoidance system;" "As automatic braking becomes more common in cars, so do driver complaints;" and "Thanks autopilot: Cops stop Tesla whose driver appears asleep and drunk" (*4–7*).

If one thing has been learned from early experience with these systems, it is that safety engineering alone is unlikely to solve these problems. Until driving is fully autonomous, advanced driver-assistance systems must rely on the active and intelligent participation of human drivers. Drivers and technology need to work together as a team, each making a unique contribution and helping to overcome the limitations of the other. For now, the dream of pushing a button, directing one's attention elsewhere, and assuming that all will go to plan remains a dream.

The industry has begun to reengineer the vehicles. Now it is time to reengineer the minds of the drivers. But how many people would be willing to sit through training for something that they have been doing their entire adult lives? And would driver training really make a difference in safety outcomes? Research is under way to answer these very questions.

Do Drivers Really Need Training?

To many, sitting through a training course on how to push a few buttons on a steering wheel or dashboard seems unnecessary. After all, since the 1980s, designers have focused on creating intuitive, "user-friendly" interfaces. Why can't we provide drivers with automated support for familiar driving tasks and simply tell them that the technology isn't perfect: that they need to keep paying attention, and if anything looks strange, to take over and drive? What else is there to know?

One trap that drivers already fall into is a belief that the automation is more capable than it really is. It is easy to imagine that computers have the same common-sense understanding of the world as humans do, but nothing could be further from the truth. Situations that seem trivial—that humans take for granted—often are beyond the capabilities of the most sophisticated automation system.

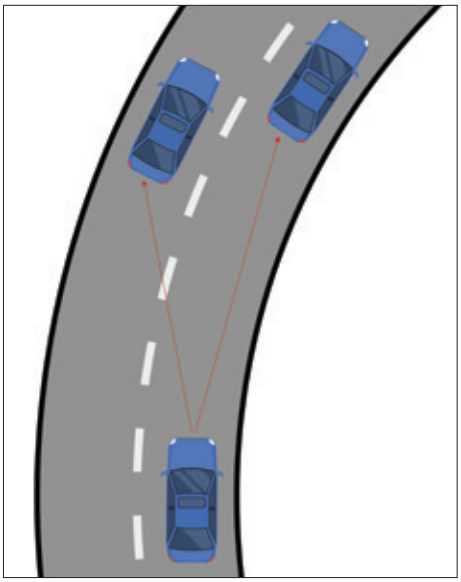


FIGURE 1 Optical tricks easily processed by the human brain may confuse automated systems.

Suppose your lane-keeping system is engaged and your car is tracking another car in front of you. If you round a sharp corner, you will likely pay little attention to the fact that two cars now appear in your windshield scene. The car you are following appears on one side of your windshield and a car that is driving in the adjacent lane appears on the other side of your windshield—an optical feature of curves that the human brain can easily handle (see Figure 1, above). To a computer vision program, however, it is just an array of shapes and colors. Could the automation confuse the two cars? Could it try to follow the other car and drift into the other lane? If yet another car comes up beside you in that lane, would your collision-avoidance system scream at you or take over if that car tried to change lanes? Would the lane-keeping system fight for control with the collision-avoidance system? These are not easy questions to answer.

Photo: Roberto Nickson/Unsplash

Until fully automated driving is possible, advanced driver-assistance systems must rely on the participation of human drivers. This may require a new type of driver training.

Photo: David Emrich/Unsplash

Drivers often underestimate the role of human passengers in their driving decisions.

Accompanying the common misunderstandings about how systems work often is an overconfidence in understanding how the systems work. Confused about what computers can and cannot do—and what we know and don't know about them—we tend to trust more than we inquire. Study after study shows how people tend to bow to the authority of computing systems they do not understand—even when it becomes apparent that the systems don't work all that well. In our minds, it is as if computers are endowed with superior intellect as soon as they roll off an assembly line.

Not only do we overestimate what computers can do for us, we also tend to underestimate what human passengers do for us. People seldom are aware of the subtle feedback they get when they work in the presence of other humans. Invite someone to sit in the front passenger seat of your car. You likely will observe them chime in with a little help. They may clear their throats, point things out, tense up, roll their eyes, and make snarky comments—all of which serve to direct our attention to things that we might have missed. For whatever reason, however, few of these feedback cues are incorporated into driver automation systems. The industry tends to design strong, silent automation interfaces that don't offer many clues about how they are classifying what they sense or what they plan to do next.

All the while, these systems harness the power to intervene in our driving by nudging our steering wheel or slamming on the brakes.

Who Wants It?

Just because we think that training is needed does not mean that people will want it. Instruction manuals are known to receive scant attention from product users and driver manuals are no exception. The openness of most people to receiving "frontal lectures," especially about already-familiar topics, isn't much better.

Driver automation may be an exception, however. New car buyers seem to understand that there is something special about vehicle automation and may be more willing to learn more about it. A revealing study done by State Farm found that 51% of all drivers surveyed consider training very important, while another 24% consider it somewhat important (*8*). A similar study conducted by Hillary Abraham found that 68% of all new car buyers received between zero and 29 minutes of instruction on their new car, and more than half of them expressed a desire for more instruction (*9*). It could be that beneath the desire for vehicle automation training is the reassurance that the *other drivers* will get it, too.

The other stakeholders in this emerging industry are insurance companies. If training can help avoid crashes, then that means fewer claims and fewer payouts. But does training really help?

Will Driver Training Make a Difference?

Training takes time and costs money. It is fair to ask whether the investment would yield returns in the form of improved safety outcomes. This question has been considered before, with high school driver education programs. Years ago, a driver education course was a standard part of almost every high school curriculum. Students learned in the classroom and then spent time behind the wheel with a driving instructor.

Over the past decade, however, these programs have all but disappeared. School budget cuts receive some of the blame, while an increasing emphasis on preparation for college entrance exams claimed another portion of students' time

and schools' money. A series of studies appeared to demonstrate that high school students who completed an in-school driver education program crashed no less frequently than students who did not get the training (*10*).

As training for the old kind of driving was eliminated, a new kind of driving began to emerge. Today, vehicle automation and smartphones lure us into distraction. Work and life schedules are busier, and we are seeing a corresponding increase in speeding and driver aggression.

Many have argued that older driver education programs failed to achieve a reduction in crashes simply because they did not teach students the right things. Instead of simply logging hours behind the wheel, some argued that students should be taught core cognitive skills such as hazard anticipation and perception. Researchers in the automotive industry are already looking at the effectiveness of training programs focused on vehicle automation.

A group at BMW investigated what would happen if drivers followed the oft-given advice to read the manual. They found that requiring study participants to read the manual resulted not only in improved understanding of the automation system but also in driver interaction with the equipment, as judged by the experimenters. Well aware of the challenges of getting drivers to read manuals outside of an experimental setting, the BMW group found that even greater gains were made when training took the form of video or an interactive tutorial—or, even better, a driving simulator.

Taking the simulation idea to its limit, Madi Ebnali of the University of Buffalo is conducting a study on the use of immersive virtual reality to provide trainers and drivers with low-cost, engaging simulated driving experiences.

A study by Alexandria Noble at Virginia Tech Transportation Institute found that the greatest improvements in driver attitudes and behavior occurred when trainees were provided with test-track driving experience (*11*). Noble and colleagues found that continued practice with the automation helped reinforce what each participant had learned during the training episode. The problem is that test tracks and long training courses are not a viable option for all drivers, and it isn't possible to have a driving instructor or human-factors researcher ride along with a new car owner for several months after the purchase. Or is it?

Photo: Clément/Flickr

As with traditional driving instruction, a solid understanding of the concepts of automation is most effective—not just knowing which buttons to press.

In the Netherlands, Anika Boelhouwer is developing an in-vehicle tutor that plays the role of a driving instructor (*12*). Naturally wanting to avoid installing a digital "backseat driver" in cars, Boelhouwer first conducted an observational study of driving instructors, professionals who are trained to help a driver—without driving them crazy. Every good instructor knows that there is a subtle art to knowing when to speak up and when to remain silent.

Realizing the importance of what is said to the driver during a lesson, the BMW researchers are examining how real-time appraisals of driver performance affect their learning trajectory. Lending encouragement to other in-vehicle support efforts, the study done by Abraham and others at the Massachusetts Institute of Technology found that 25% of new car buyers welcomed instruction provided by the car itself (*9*).

What we teach also matters. Studies have shown us that simply memorizing button-pushing procedures is not enough. Taking the time to understand how the automation works pays off when users are presented with real-life situations that may differ from the ones they practiced during training. Understanding the foundations that underpin the familiar button-pushing procedures also helps users to remember these procedures if they have not exercised them in a while or even to come up with alternative ways of accomplishing the same task.

Martin Krampell and colleagues at Volvo are already studying the effects of teaching conceptual models of how automation works and have found that drivers who are given a deeper, more-conceptual understanding of the automation also are more likely to retake control of the vehicle during critical situations (*13*).

Conclusion

Today, partial autonomy is being deployed in cars en masse. Advanced driver assistance systems rapidly are becoming standard features for all light-duty cars and trucks. Studies of behind-the-wheel smartphone use assure us that this behavior—now responsible for as many as one-fourth of all crashes—shows little sign of moderation. Further, driving as a task

One trap that drivers already fall into is a belief that the automation is more capable than it really is.

is growing more and more complex each year, without a reciprocal level of understanding from the public.

But won't drivers eventually figure it out or use their common-sense intuitions, proceed cautiously, and learn as they go? That is unlikely because, as we have seen, our common-sense intuitions often are spectacularly wrong when they are placed in front of modern technology. When crashes happen, rather than acknowledging this situation, we often distance ourselves by dismissing those involved as bad actors who possess poor judgment, who lack responsibility or basic common sense, or who are simply members of a problematic generational cohort.

There is more at stake than overall crash statistics here. How will these issues play out during litigation? It is important to realize that the problems with human–automation interaction are being thoroughly documented in scientific studies and that equally thorough solutions have yet to be identified. More research is needed to help answer these and other questions as hundreds of millions of drivers participate in the largest-scale experiment ever conducted on the nation's roadways.

REFERENCES

1. Cicchino, J. B. Effects of Rearview Cameras and Rear Parking Sensors on Police-Reported Backing Crashes. *Traffic Injury Prevention*, Vol. 18, No. 8, 2017, pp. 859–865.
2. Kidd, D. G., and A. T. McCartt. Differences in Glance Behavior Between Drivers Using a Rearview Camera, Parking Sensor System, Both Technologies, or No Technology During Low-Speed Parking Maneuvers. *Accident Analysis & Prevention,* Vol. 87, 2016, pp. 92–101.
3. Kidd, D. G., B. Reimer, J. Dobres, and B. Mehler. Changes in Driver Glance Behavior When Using a System That Automates Steering To Perform a Low-Speed Parallel Parking Maneuver. *Transportation Research Part F: Traffic Psychology and Behaviour,* Vol. 58, 2018, pp. 629–639.
4. Lekach, S. Tesla's Autopilot keeps crashing into parked cars. Here's why. *Mashable.* May 30, 2018. https://mashable.com/2018/05/30/tesla-autopilot-stationary-crashes.
5. Turner, B. Don't blindly trust your car's collision avoidance system. *Driving.* March 5, 2015. https://driving.ca/auto-news/news/dont-blindly-trust-your-cars-collision-avoidance-system.
6. Foldy, B. As Automatic Braking Becomes More Common in Cars, So Do Driver Complaints. Wall Street Journal. Aug. 27, 2019. www.wsj.com/articles/as-automatic-brakes-become-common-so-do-driver-complaints-11566898205.
7. Lee, T. B. Thanks autopilot: Cops stop Tesla whose driver appears asleep and drunk. *Ars Technica*. May 18, 2019. https://arstechnica.com/cars/2019/05/dutch-police-pull-over-tesla-with-apparently-sleeping-drunk-driver.
8. Mullen, C. Driver's Role and Importance of Consumer Education. Presented at Reaching Zero Crashes: A Dialogue on the Role of Current Advanced Driver Assistance Systems, National Transportation Safety Board and National Safety Council, Washington, D.C., 2017.
9. Abraham, H., B. Reimer, and B. Mehler. Advanced Driver Assistance Systems (ADAS): A Consideration of Driver Perceptions on Training, Usage & Implementation. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting,* Vol. 61, No. 1, 2017, pp. 1954–1958. https://doi.org/10.1177/1541931213601967.
10. Vernick, J. S., L. Guohua, S. Ogaitis, E. J. MacKenzie, S. P. Baker, and A. C. Gielen. Effects of High School Driver Education on Motor Vehicle Crashes, Violations, and Licensure. *American Journal of Preventive Medicine,* Vol. 16, No. 1, 1999, pp. 40–46.
11. Noble, A., S. Klauer, Z. Doerzaph, and M. Manser. Driver Training for Automated Vehicle Technology: Knowledge, Behaviors, and Perceived Familiarity. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting,* Vol. 63, No. 1, pp. 2110–2114. https://doi.org/10.1177/1071181319631249.
12. Boelhouwer, A., A. P. van den Beukel, M. van der Voort, and M. Martens. Designing a Naturalistic In-Car Tutor Systems for the Initial Use of Partially Automated Cars: Taking Inspiration from Driving Instructors. In *Proceedings of the 11th International Conference on Automotive User Interfaces and Interactive Vehicular Applications (AutomotiveUI '19).* Association for Computing Machinery, New York, 2019, pp. 410–414. https://doi.org/10.1145/3349263.3351504.
13. Krampell, M., I. Solís-Marcos, and M. Hjälmdahl. Driving Automation State-of-Mind: Using Training to Instigate Rapid Mental Model Development. *Applied Ergonomics*, Vol. 83, 2020. https://doi.org/10.1016/j.apergo.2019.102986.

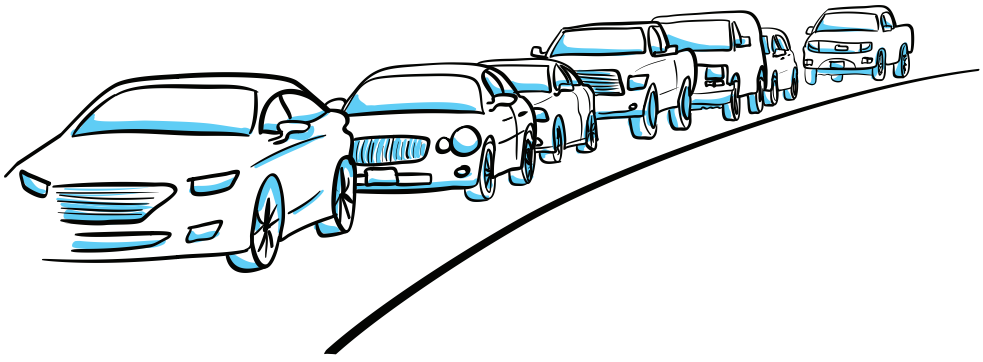
RESOURCES

Casner, S. M., E. L. Hutchins, and D. A. Norman. The Challenges of Partially Automated Driving. *Communications of the Association for Computing Machinery*, Vol. 59, No. 5, 2016, pp. 70–77.

Casner, S. M., and E. L. Hutchins. What Do We Tell the Drivers? Toward Minimum Driver Training Standards for Partially Automated Cars. Journal of Cognitive Engineering and Decision Making, Vol. 13 No. 2, 2019, pp. 55–66.

Forster, Y., S. Hergeth, F. Naujoks, M. Beggiato, J. F. Krems, and A. Keinath. Learning to Use Automation: Behavioral Changes in Interaction with Automated Driving Systems. Transportation Research Part F: Traffic Psychology and Behaviour, Vol. 62, 2019, pp. 599–614.

Shladover, S. E. The Truth About "Self-Driving" Cars. Scientific American, Dec. 1, 2016. www.scientificamerican.com/article/the-truth-about-ldquo-self-driving-rdquo-cars.



MORE THAN JUST CAMERAS Video-Based Onboard Monitoring Systems for Fleet Safety

Photo: Raymond Shobe, Flickr

ERIC COHEN

The author is Marketing Manager, SmartDrive, San Diego, California.

Above: A truck travels down I-10 in Banning, California. A Highway Safety IDEA project developed a prototype system that provides driver and administrator feedback on various risk factors for truck crashes.

Trucking companies take managing risk and operating safely very seriously—not only to ensure the safety of their employees and the general public, but also for the secure transportation and delivery of the materials they haul. In addition, a safer fleet reduces costs, fleet claims, and litigation, while improving operational efficiency.

Video-based onboard monitoring systems have reported such benefits as 40% or lower driver turnover, zero U.S. Department of Transportation–recordable accidents, more than 60% reduction in collisions, and more than $1 million saved in subrogation costs. A study from the AAA Foundation for Traffic Safety found that "video-based onboard safety monitoring systems can prevent as many as 63,000 crashes, 17,733 injuries, and 293 deaths each year" (*1*).

In December 2011, the National Transportation Safety Board suggested a mandate of such systems in commercial trucks, based on a growing body of data that suggest that deployment of these systems could help reduce the number and rates of crashes for equipped vehicles. This represented a substantial step forward in both concept and capability of an affordable system.

In 2013, a Highway Safety IDEA report was published on a driver monitoring and crash risk mitigation system that could provide significant safety benefits.[1] The goal of the project was to develop and integrate hardware and software for a comprehensive, low-cost, easy-to-install driver monitoring and assistance system. The result was a prototype system that is capable of providing driver and administrator feedback about risk factors, including those that contribute to most of the crashes in the United States.

[1] The final report for Highway Safety IDEA Project 18, *DRIVE-SMART Driver Monitoring and Crash Risk Mitigation System,* can be found at www.trb.org/Main/Blurbs/168922.aspx.

Photo: AAAFTS

A 2017 study from the AAA Foundation for Traffic Safety estimated the costs and benefits of equipping large trucks with video-based onboard safety monitoring systems.

Companies have many options when choosing vehicle safety technologies. In recent years, the advent of video-based safety has changed how fleets measure safety, ultimately leading to life- and cost-saving benefits. The combination of immediate video-based insights and transportation intelligence—which transforms massive volumes of data generated by fleets into real-time, actionable information—provides fleets with predictive analysis and prescriptive actions, leading to significant business results.

Video-based safety systems offer the context, flexibility, and insights that facilitate driver exoneration and improvements in driver performance, compliance with standard operating procedures, improved customer service, and more. As such, video can have almost immediate benefits, delivering significant return on investment and an ongoing, positive impact to a fleet's bottom line.

Exonerating Drivers

A key reason fleets adopt video-based solutions is driver exoneration. When fleet drivers are involved in a crash, drivers of commercial vehicles often are assigned blame regardless of the severity or who truly is at fault. When a fleet driver is involved in a collision, it often simply comes down to differing verbal accounts of the incident. So, how can it be determined—and proven—what really happened?

With video, fleet managers can know within minutes what actually caused a collision. When not at fault, the driver can be exonerated quickly, preventing a costly claim against the transportation company or enabling the fleet to file a claim for damages. The certainty conferred by video footage can prevent the driver from receiving a citation and potentially losing their commercial driver's license. Alternatively, if the company driver is at fault, video footage can illuminate the circumstances, speeding the claims resolution process.

Not All Video Systems are Created Equal

There is more to the decision to install a video-based safety system than just cameras and the actual video of a driving event. Video alone does not make a fleet safer—identifying risk and taking action to reduce those risks are critical.

A fleet's collision frequency depends largely on the skills and abilities of its drivers, which is why human factors represent the biggest opportunity to improve safety and efficiency. Preventing driver-caused collisions is challenging because driver-related risk factors must be measured on the roadway before a collision occurs and then addressed in a timely manner. But how do fleet managers know what risky habits their drivers are engaging in while on the road? And with limited time and resources to coach, how do they know which drivers to prioritize based on severity of risk? Many fleets worry that the amount of video will be overwhelming.

To ensure a fleet gets the right amount of video, while reducing the time and resources needed to spend on the program, a managed service that includes a proven coaching workflow will yield the best results, particularly when part of a converged solution that combines computer vision with compliance, telematics, video, and analytics.

Computer vision (CV) is important, but without iterative human review, the machine is not yet smart enough to determine what is truly an obstruction (or not). A large number of false positives will reduce program accuracy and efficiency if not managed. A managed service uses human review to save time by only giving actionable information to the fleet and its drivers. It is important that the program provide the fleet with the ability to customize all scoring, rules, and alerts to ensure the most egregious behaviors are flagged and addressed immediately.

Photo: Oregon DOT

Trucks along I-84 in the Columbia Gorge, Oregon, after a series of crashes closed the highway.

What is not immediately apparent in many CV-flagged risky driving videos is that drivers have become desensitized—that is, once drivers realize the alerts are sometimes false, they lose confidence in the data and ignore the alerts.

Unlike a dashboard camera or CV-only service, a video safety program with a managed service provides consistent, unbiased, and professional reviewing, scoring, and prioritizing of thousands of videos. An in-vehicle monitoring system supplemented by a managed service also provides:

- Custom scoring of events based on the fleets' safety and compliance priorities;
- Fair, unbiased, and consistent reviews for every driver across fleets;
- Coverage in case an incident occurs at night, on the weekend, or on a holiday;
- Expert analysis and a unified view of risk and vehicle performance; and
- Proven processes that deliver substantial results from a scalable solution.

A managed service delivers actionable data for coaching drivers on specific skills or habits and prioritizes events for coaching based on the severity of risk and company policies. Once risk has been identified, the next and most important step is coaching. An intuitive coaching workflow—a critical component of a managed service solution—combined with easy-to-use tools is essential to improving driver performance and reducing risk.

The scoring and prioritization used by experts in video analysis are critical to the success of a video-based safety program. Without this, it is virtually impossible for managers to differentiate between a driver who is actually improving and one who is just getting lucky. Managers and coaches tasked with reviewing massive volumes of raw driver data may not know, or have the bandwidth, to assess what's important, when to intervene, and how to reduce risk.

With a managed service, fleet managers can access a real-time stream of analyzed data that accurately measures a driver's exposure to risk. A more complete picture is painted with information on the triggering event, observed behaviors, risk exposure metrics based on predictive algorithms, and correlations to prior collision data. This information can provide accurate and timely measurements of drivers' risk, enabling coaches to intervene and focus on the drivers most likely to have a collision or be involved in other incidents.

Expert, consistent, and nonbiased review is essential to every video-based program. Trying to operate this type of program internally can rack up costs and burden employees, however, and can deepen issues with driver acceptance. By tapping a third party to review and score triggered videos, companies get 24/7 coverage in case there is an incident during off hours; scalability as the fleet grows; and fair, consistent reviews for every driver across the fleet.

The Impact of Video

As shown in Figure 1 (page 33), the impact of a video-based safety program is immediate and reflected in a driver safety score, a leading indicator that equips fleets to objectively assess driving performance and compare drivers, sites, and other segments of the business. It is an objective measurement of specific driving habits—including speeding, seat belt usage, distracted driving, and others—that increase risk and the likelihood of collisions.

The effect of the new program can taper off over time, however, for fleets that do not engage in continued coaching with drivers. Without coaching, the safety score shoots back up and continues to fluctuate up and down; for fleets that are highly engaged in a coaching program with their drivers, the safety score drops and remains low.

A fully managed service delivers the right information to the right people at the right time, allowing appropriate actions to prevent collisions and improve driver skills. Utilizing a managed service program empowers fleets to focus on risk areas that have the biggest impact, alleviating the burden of extensive video review and analysis. This saves companies time and money. By obtaining insights into the safety of each driver through expert analysis of individual driving events, managers gain overall insight into the safety of the company.

Video Enhancing Resources

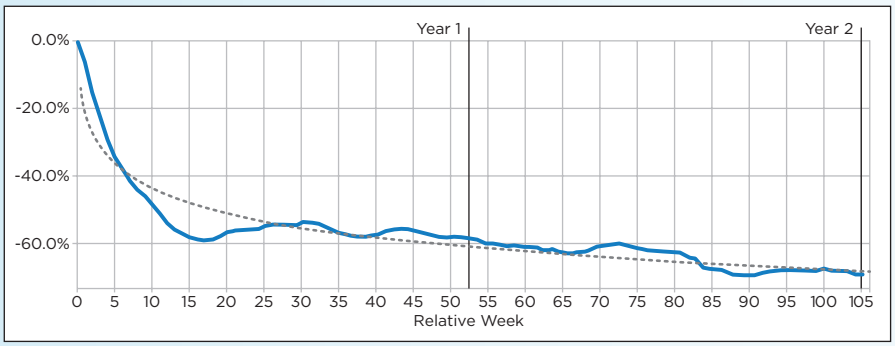
Keeping a fleet competitive requires a continued focus on resources, managing both overhead and technology investments. As fleets expand, drivers, dispatchers, and managers must work together to achieve safety goals without increasing overall cost.

It takes more than just video to deliver the insights needed for a lasting impact on safety, however. If a fleet has 1,000 vehicles, each with cameras installed, a massive amount of video is collected in a short amount of time. Very few fleets have the internal resources to review this volume of footage. Further, for fleets that require extended recording to ensure a clear record of all activity and incidents, the amount of video is never-ending.

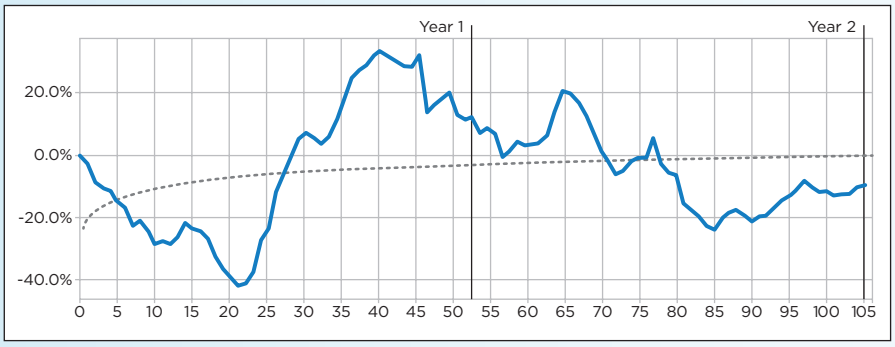
For this reason, the best configuration for most fleets is to have a robust exception-based video recording system that deploys artificial intelligence, CV, and machine learning—along with human review. For example, unlike a DVR that continuously records and saves video for review, an exception-based system only records when something occurs outside of a specified range of expectations—in this case, when there's a hard brake, sudden acceleration, swerve, U-turn, or other unusual driving event. These systems feature a finely tuned triggering mechanism that can detect whether the vehicle is driving on the street or on a job site.

For instance, this is particularly important with construction vehicles because of the conditions of construction sites compared with most roadways. Because these surfaces are extremely different, a G-force movement on one might be completely normal but on another could indicate an unsafe situation. By combining exception-based and continuous recording, areas of risk can be addressed quickly and responsibly, and the full record of activity is available for reference when needed.

Construction and ready-mix fleets that use a video-based safety system (in this case, SmartDrive)—combining artificial intelligence, CV, and machine learning with a managed service—have seen reductions in distracted driving and mobile phone



(a)



(b)

FIGURE 1 Change in safety score for high-engagement companies (*a*) and low-engagement companies (*b*) after implementation of video-based safety system.

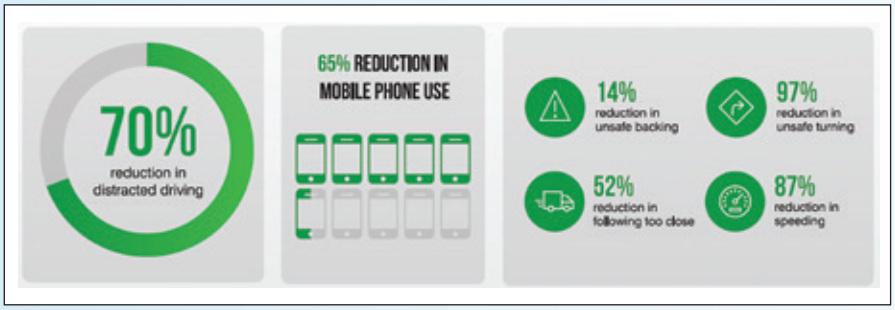


FIGURE 2 Fleet-reported effects of video-based safety systems.

use, unsafe turning, speeding, and more (see Figure 2, above).

Counteracting Data Overload

Vehicles are loaded with sensors that generate huge quantities of data, which can be a major headache for fleets to analyze on their own. It's important to remember that video-based safety programs deliver insight—not just data. Solutions with an open-platform approach are able to incorporate a variety of inputs from other safety technologies on the vehicle, allowing an in-vehicle monitoring system to trigger a video event based on hard braking, following distance, lane departure, and more.

This creates leverage across fleet safety investments by providing a single, consolidated view of the driving environment, the driving maneuvers, and the vehicle. Because advanced in-vehicle monitoring systems are able to offload and alert managers in real time, fleets have immediate access to the most important information to make fast and effective decisions.

An array of actionable business intelligence—such as operational metrics, management key performance indicators, reports and dashboards for managers, and interactive visualizations for advanced analysis, as shown in Figure 3 (page 34)—is the key to changing behavior and driving success. But is that the goal or merely the starting point?

Key to Success

An in-vehicle monitoring system is a tool for fleet safety, but a strong safety culture is the key to success. Although few question the importance of safety, it can be difficult to change an organization's safety culture and it is challenging to teach drivers new safety skills, effectively enforce existing policies, and eliminate risky behaviors that have been engrained over many years of service.

Coaching and driver training are necessities in developing a culture of safety. It's important that safety performance is frequently addressed and that drivers receive feedback promptly after incidents. Recent innovations in transportation technology now alert managers to incidents in real time through video-based safety and transportation intelligence platforms that record high-risk driving situations. These systems give supervisors the tools to provide the timely feedback required for true change and to make evaluation a regular part of the safety culture.

When building a culture of safety, fleets must set clear expectations for each driver and take the time to explain the factors affecting the driver's safety score and how they can improve. Technology empowers managers to understand their own program analytics and define the organization's key performance indicators, but that information is only effective if it is regularly communicated to each driver. When drivers understand the organization's goals and where they fit in, they become key players in furthering the organization's safety mission by developing a positive safety culture.

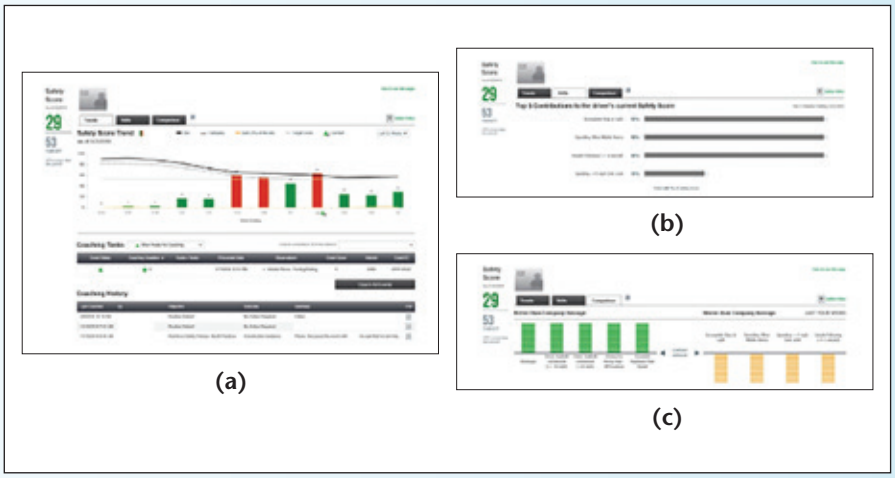


FIGURE 3 Trends seen in a historical view of driver performance (*a*), opportunities for biggest improvement (*b*); and benchmarking for skills assessment (*c*).

Data and Analytics for Prediction

Data are transforming the way fleets of all sizes make decisions that improve efficiency, productivity, and ultimately profitability (see Figure 4, below). Today's connected vehicles are loaded with sensors that deliver massive volumes of rich data that fleets can leverage to help answer the following types of questions about every aspect of fleet performance:

- What happened?
- How or why did it happen?
- What's happening now?
- What is likely to happen next?
- How can I avoid what might happen next?

Analytics help fleets engage with drivers, while improving safety, and operational efficiencies in some of the areas listed below.

FUEL ECONOMY

The trucking industry spent $89.7 billion buying diesel fuel in 2016 (*2*). On average, fuel costs from idling are $10,125 per vehicle per year (*3*). By analyzing fuel usage, fleets can improve fuel efficiency and savings, as every extra 10% of idle time equates to an additional percentage point in fuel economy savings (*4*). Fleets can pinpoint the biggest opportunities for improvement (for example, drivers, sites, and vehicles) and take full control of idling expense by tracking, monitoring, and optimizing the cost of idling on a daily basis. Fleets can then improve fuel efficiency and savings by understanding speeding, identifying efficient and inefficient vehicles, and identifying inefficient drivers (and coaching when needed).

SPEEDING

Increasing highway cruising speed from 55 mph (90 km/h) to 75 mph (120 km/h) can raise fuel consumption by as much as 20% (*5*). Video-based systems allow fleets to monitor when a driver exceeds the posted speed limit or a company's preset limit. By focusing on speeding, fleets can optimize fuel consumption by implementing speeding guidelines, pinpointing fuel-efficient and inefficient vehicles, uncovering improper vehicle use, and identifying drivers who are habitual speeders.

DRIVER SCORES

Fifty-two percent of drivers leave their current employer to make more money elsewhere, according to a recent survey (*6*). By analyzing driver safety scores, fleets can measure driver performance across key safety, efficiency, and operational metrics; determine drivers' eligibility for incentive programs; and identify and reward top drivers, using performance-based metrics that matter.

Best-run fleets use data and analytics from their fleet management software to predict problems, trends, and behavior patterns.

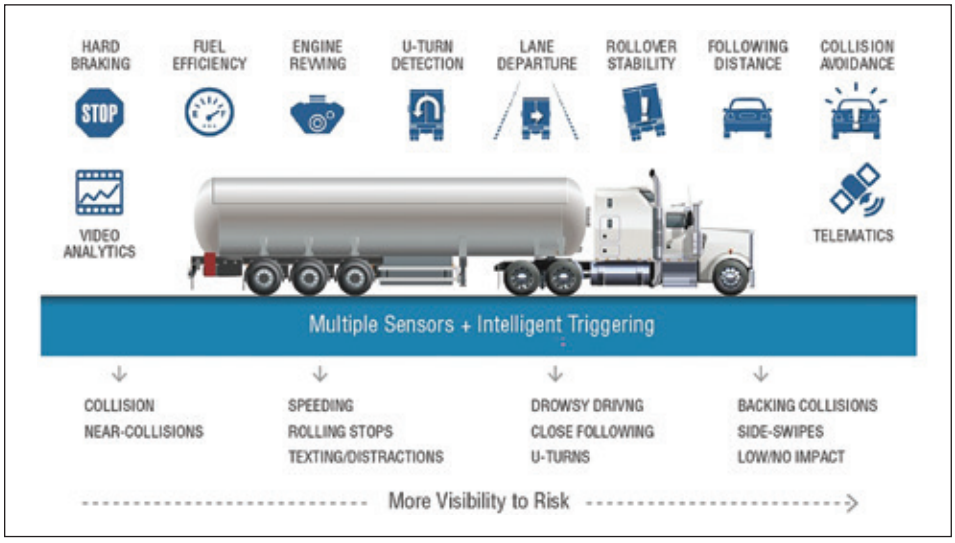


FIGURE 4 Sensor-equipped vehicle capabilities.

Analytics for Key Business Goals

Armed with actionable insights from analytics on the way their fleet, drivers, and vehicles operate, fleet managers can begin setting goals to transform their fleet. How fleets apply analytics will depend on critical business needs. These vary from fleet to fleet, but some common concepts for leveraging analytics include:

- Reducing collisions through coaching,
- Improving driver retention and reducing turnover, and
- Optimizing fuel economy and lowering idling expenses.

Building the required in-house analytical capabilities can be time consuming and very expensive. To help fleets save time and resources, a video-based safety program can provide full analytical software services at a fraction of the cost of developing similar capabilities in-house, including decision-ready, state-of-the-practice metrics designed to answer safety and operational questions, including:

- Are we reducing our collision frequency and costs?
- What are my site's riskiest driving skills?
- Who are my top-performing drivers? How should we recognize and reward their good performance?
- What are the root causes of excessive idling across my fleet and where is it occurring?

Fleet managers can use this information to positively affect their operations, eliminate risky driving behaviors, and ultimately increase profitability. A sample of reports is shown in Figure 5 (below).

A video-based safety program is more than just video—it also is the data produced from that video, which facilitates fleets to take a closer look at their operations and determine where emphasis should be placed to make the biggest difference in their fleet. Regardless of where that emphasis may be directed—driver exoneration, coaching, or reducing idling—the effects can significantly impact the bottom line.

REFERENCES

1. Johnson, T. Truck Safety Technology Can Prevent 63,000 Crashes Each Year. Sept. 21, 2017. https://newsroom.aaa.com/2017/09/truck-safety-technology-can-prevent-63000-crashes-year.
2. www.trucking.org/News_and_Information_Reports_Energy.aspx.
3. Cathey, K. The Real Cost To Idle. *TRUCK Smart*. Dec. 17, 2012. www.teamrunsmart.com/articles/truck-smart/fuel/december-2012/the-real-cost-to-idle?feed=blogs.
4. Lockridge, D. 7 Ways to Cut Idling Costs. *HDT Truckinginfo*. July 8, 2013. www.truckinginfo.com/channel/drivers/article/story/2013/07/7-ways-to-cut-idling-costs.aspx.
5. Fuel Efficient Driving: How to Save Money on Fuel Costs While Reducing Greenhouse Gas Emissions. Eartheasy. http://eartheasy.com/move_fuel_efficient_driving.html.
6. 2018 Transportation Spotlight Report. HireRight. www.hireright.com/resources/view/2018-transportation-spotlight-report.

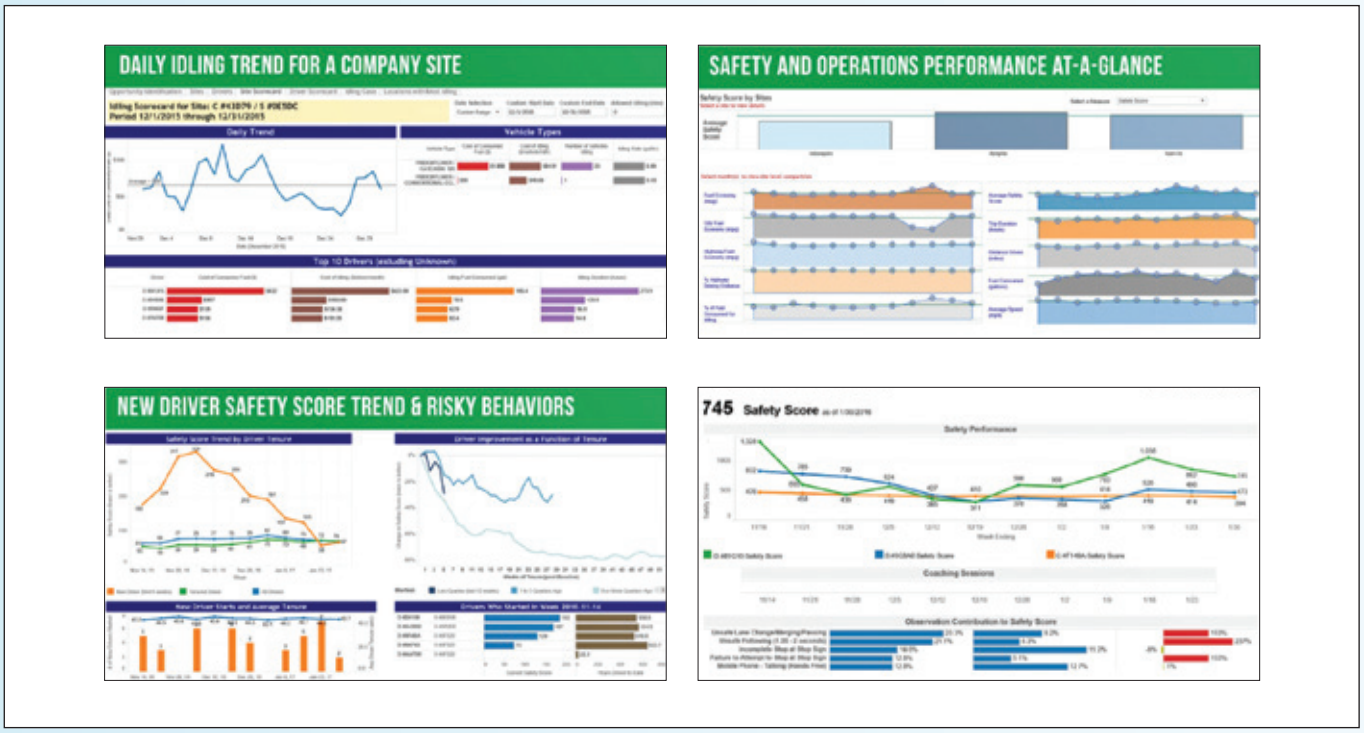


FIGURE 5 A sample of video-based safety system reports.

STANDARDS FOR ACCESSIBLE RAIL SLEEPER COMPARTMENTS

Photo: jshyun, Flickr

KATHARINE HUNTER-ZAWORSKI

The author is Associate Professor, Oregon State University, Corvallis.

Above: A TRB Rail Safety IDEA project addressed design standards for accessible sleeper railcars.

The U.S. Access Board's Rail Vehicle Access Advisory Committee (RVAAC) identified the development of fully accessible sleeper compartments as an urgent issue for the rail industry. People with mobility impairments who travel on long-distance trains often are highly restricted in their access to onboard amenities such as the dining, lounge, or observation cars. A project of the Transportation Research Board's Innovations Deserving Exploratory Analysis (IDEA) program designed, modeled, and validated new design standards for an accessible sleeper compartment for long-distance passenger rail.

The project advisory committee members, some of whom also serve on RVACC, advised the research team to develop the detailed design for a bilevel car. The objective of the project was to design a sleeper compartment that accommodates people with disabilities traveling together by providing two sleeping berths at floor level. In addition, the new sleeper compartment includes two upper-level sleeping berths. The suggested design has four revenue seats and berths in the accessible sleeping compartment and is designed to accommodate families that can include two people with disabilities traveling together. This design feature is not available on any accessible sleeper compartments in North America.

On the train, the accessible sleeping compartment would be located in the sightseeing–lounge car, adjacent to the entry vestibule that is equipped with an onboard lift, allowing access to the train from the platform and near an onboard elevator for access to the upper level. The lounge or observation car usually is located next to the dining car and the elevator would not affect revenue seating.

A key part of the design optimization is to balance the use of space with the impact on revenue seats. All these considerations would enable passengers with reduced mobility to access the sightseeing or lounge cars and would improve their train travel experience.

Accessible Design

Familiar with the operating environment of high-speed and long-distance trains, the project advisory committee provided input to establish user and technical requirements for the sleeper compartment regarding dimensions, materials, standards, and safety and crash regulations for high-speed, long-distance trains. This working group included representatives from the U.S. Department of Transportation, the U.S. Access Board, Via Rail Canada, Amtrak, and several railcar builders.

The design was modeled and a human factors evaluation was conducted on the design. Next, a full-scale, soft mockup of an accessible sleeper compartment that contains a restroom with an accessible toilet and shower was built for evaluation by people with disabilities.

The bilevel sleeper spans the full width of the train and permits the 360-degree rotation of a large wheeled mobility device in the sitting and sleeping area. The restroom includes a fully accessible shower that is equipped with a fold-down seat and adjustable-height showerhead. The restroom permits a fully assisted transfer from a large wheeled mobility device to the toilet and includes space for a securement device for an unoccupied wheelchair. Figure 1 (at right) shows a schematic with key dimensions of the accessible sleeper compartment.

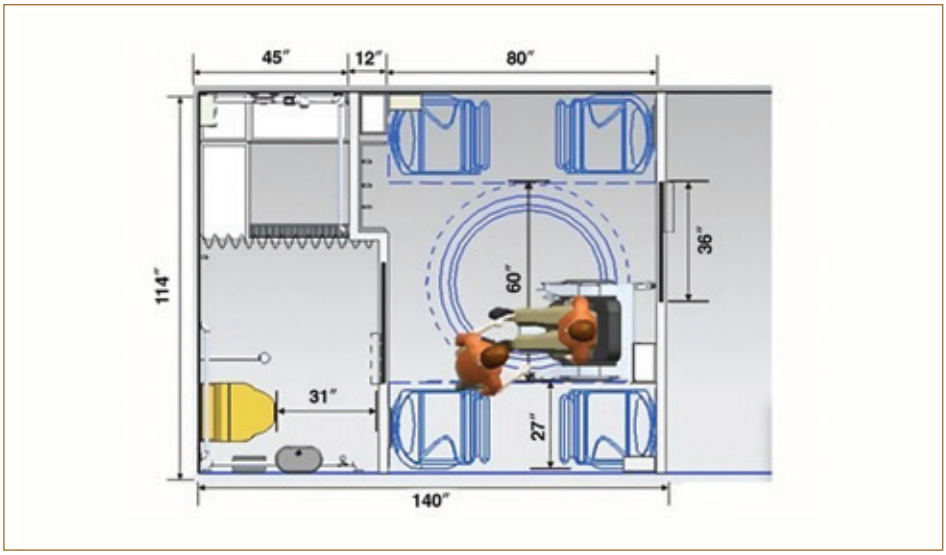


FIGURE 1 Schematic accessible sleeper design for a bilevel car, with 95th-percentile male human models positioned representative of a transfer from a large power-base wheelchair.

Figure 2 (below) shows the soft mockup. This version of the design accommodates up to four passengers with two sleeping berths at floor level and two upper bunk beds. The soft mockup that the research team used during the evaluation permits flexibility to adjust some of the spatial arrangement of features.

Next Steps

It is anticipated that the design guidelines for the sleeper compartment will assist with the rail industry's introduction of the universal sleeper compartment modules for the next generation of long-distance and high-speed trains for persons with mobility and sensory impairments, as well as senior citizens.

The next steps in development include installing and testing the soft mockup on bilevel rail cars already in use for evaluation by more people with reduced mobility. Also needed is further design development of a single-level sleeping compartment that includes a restroom without a shower and a separate accessible shower compartment. Other passengers could use the accessible shower compartment, which would be located adjacent to the accessible sleeping compartment on a single-level train.

The IDEA project results indicate that it is possible to have new accessible sleeping compartments with two lower berths that will increase access and improve the train travel experience of travelers with reduced mobility.

FIGURE 2 Soft mockup in day and night.

Drones and Lasers Enable Safe Railroad Bridges Operations

Photo courtesy Fernando Moreu

NANDO MOREU, ROYA NASIMI, MAHMOUD REDA TAHA, PIYUSH GARG, VELVET BASEMERA-FITZPATRICK, DAVID L. MASCAREÑAS, AND MARTITA MULLEN

Moreu is Assistant Professor, Nasimi is Research Assistant, and Reda Taha is Distinguished Professor and Regents Lecturer and Chair, Department of Civil, Construction and Environmental Engineering, University of New Mexico, Albuquerque; Garg is Developer, Presto, Inc., San Mateo, California; Basemera- Fitzpatrick is Senior Program Officer, Transportation Research Board, Washington, D.C., Mascareñas is Research and Design Engineer, Los Alamos National Laboratory, New Mexico; and Mullen is Senior Manager, Design and Construction, Canadian National Railway Company, Homewood, Illinois.

Monitoring bridge displacements under freight traffic can provide bridge managers with an objective indicator of safe and cost-effective operations. Excessive displacements that occur when trains cross a bridge can be used to compare bridge performance and to ensure safety of operations, whether to compare performance on the same bridge over time or compare bridge performance across a network of bridges. Railroad engineers want to quantify displacements that they can add to their regular inspections to inform maintenance, repair, and replacement operations.

Collecting displacements under trains is difficult because inspectors need to climb bridges to attach sensors to the structure. Sometimes the structure is not even accessible, particularly if it crosses a body of water or a canyon. As part of the Transportation Research Board's Innovations Deserving Exploratory Analysis Program, the University of New Mexico (UNM) developed a drone-mounted bridge displacement measurement tool that allows inspectors to collect contact-free, reference-free displacements of bridges under revenue service traffic. After successful laboratory results and various field tests at Albuquerque Balloon Fiesta Park, the research team is collaborating with the railroad industry to prepare for field implementation.

The UNM research integrated noncontact and reference-free vibrometers in a drone and validated the accuracy of the dynamic displacements measured by the drone. These measurements were compared with those obtained using a linear variable differential transducer (LVDT)—the conventional method to measure displacements. The challenge of the LVDT method is that a fixed reference point is needed for measurement.

With the results of this research, and with limited added development, a bridge

Above: The UNM research team with a prototype drone used to measure bridge displacements.

inspector could wait for the train to cross, the drone hovering parallel to the bridge, and would be able to collect the displacements safely and accurately. Multiple drones also could be operated simultaneously to collect displacements from critical bridge points of interest, transmitting data to the railroad manager in real time.

Challenges

The research showed that there are hardware and software challenges to adding a laser to a drone to measure displacements, both before and after sensing. The weight and capabilities of the laser need to be compatible with the payload and stability of the drone, as well as with the drone batteries and the data acquisition equipment. Solving these challenges required close collaboration among students and professors from the UNM Departments of Civil, Construction, and Environmental Engineering; Electrical and Computer Engineering; and Mechanical Engineering.

The laser correction algorithm was programmed at the structures laboratory of UNM using shake tables, a series of different lasers, and real railroad bridge signals of various amplitudes that were collected in the field. The experiments were conducted indoors to control laser vibrations.

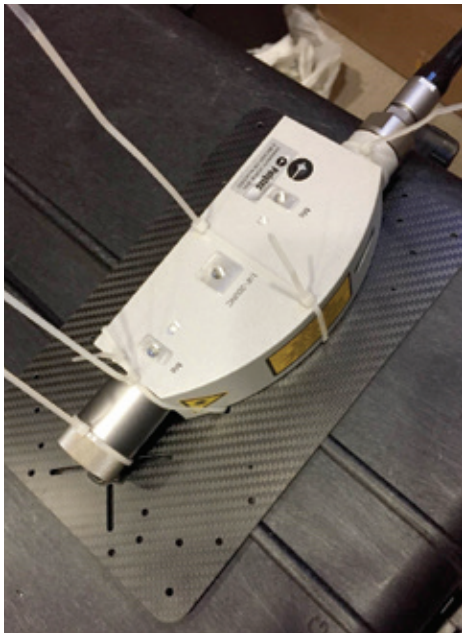


Photo courtesy Fernando Moreu

The noncontact vibrometer is attached to the drone.

The research conducted in the field tested three different field validations, moving the drone two separate distances from the target—4 and 7 meters (12 and 22 feet)—to check the effect of distance on accuracy. At both distances, the error between the displacement measured with the new drone system and with LVDT was less than 10%, an acceptable first approximation for contact-free, reference-free dynamic displacements in the field. Similarly, the research conclusions were shared with the railroad industry in various national meetings, with a consensus confirming the validity of the tested methodology outdoors before bridge measurements in the field.

Future Research Phases

The use of drones to measure displacement has been disseminated via UNM's Science Technology Center. It is under review for a patent and has been the subject of two journal papers and several presentations at national and international scientific conferences, including that of the American Railway Engineering and Maintenance-of-Way Association and the Biannual International Workshop for Structural Health Monitoring.

The second phase of this research includes the development of lightweight lasers and portable data acquisition systems on the drone, a new untethered system in which the laser can be wireless, and computer vision algorithms for total displacements monitoring.

Acknowledgments

The support of the laser company Polytec and input from many experts ensured the practical implementation of this technology. The expert review panel consisted of engineers from industry and academia: Sandro Scola, Canadian National Railways; Duane Otter, Transportation Technology Center, Inc.; and Rafael Fierro, UNM Multiagent, Robotics, and Heterogeneous Systems (MARHES) Lab. The research team thanks Chris Lippitt and Su Zhang for their assistance during the outdoor field testing.

Photo courtesy Fernando Moreu

Using drone technology to measure displacement is under review for a patent.

Implications of the California Wildfires for Health, Communities, and Preparedness

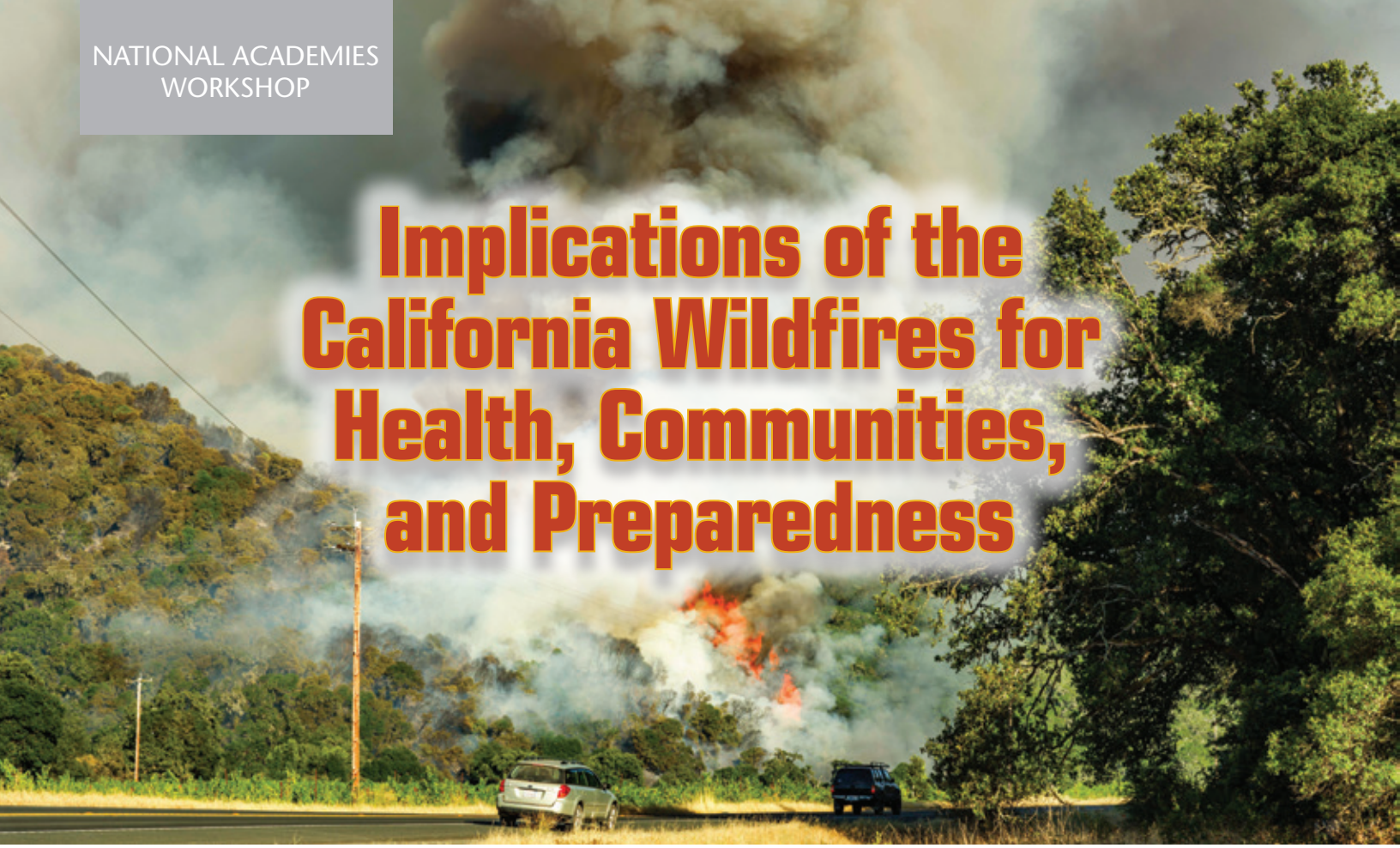


Photo: Bob Dass/Flickr

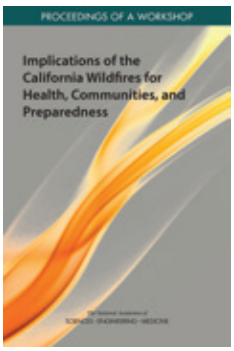
STEVE OLSON

The author is a freelance writer based in Seattle, Washington.

Above: The health implications of wildfires—which have been on the rise in California since 2000—were the focus of a 2019 National Academies of Sciences, Engineering, and Medicine workshop.

On June 4 and 5, 2019, four entities within the National Academies of Sciences, Engineering, and Medicine—the Forum on Medical and Public Health Preparedness for Disasters and Emergencies; the Roundtable on Population Health Improvement; the Roundtable on the Promotion of Health Equity; and the Roundtable on Environmental Health Services, Research, and Medicine—held a workshop titled "Implications of the California Wildfires for Health, Communities, and Preparedness" at the Betty Irene Moore School of Nursing at the University of California (UC), Davis. The purpose of the workshop was to explore the population health, environmental health, emergency preparedness, and health equity consequences of increasingly common and increasingly strong wildfires, particularly in California. Although the committee was not charged with a specific transportation-related objective, the role of transportation emerged during the workshop. This article highlights parts of the report that discuss transportation as related to wildfire-related issues.

California and other wildfire-prone Western states have experienced a substantial increase in the number and intensity of wildfires in recent years. Eight of the 10 largest wildfires in California have occurred since the year 2000. Wildfires and other disasters can be particularly devastating for vulnerable communities (*1*). Members of these communities tend to experience worse health outcomes from disasters; have fewer resources for responding and rebuilding; and receive less assistance from state, local, and federal agencies.



Implications of the California Wildfires for Health, Communities, and Preparedness: Proceedings of a Workshop is available at https://www.nap.edu/catalog/25622.

Health and Medical Responses

In California, the Emergency Medical Services Authority (EMSA) works with the Department of Public Health to provide the Emergency Support Function, which is the public health and medical response to disasters. During disasters, the 911 response is overwhelmed quickly in rural areas, remarked EMSA Director Howard Backer. California has about 40 ambulance strike teams—five ambulances plus a lead vehicle—that can come from other jurisdictions to work in the field for 3 days without having to go back to their home base.

California also has a national ambulance contract, which often is used in the Southeastern United States to respond to hurricanes but has been used rarely in California. "We had ambulances and wheelchair vans and buses and all levels of transportation staged," commented Backer. "[It is possible to] call them up and they pick up people in an orderly fashion—that is, when [the medical services staff] have time."

During the Camp Fire in Northern California—the most destructive and expensive fire in California history—there was not enough time. For example, when the hospital in Paradise, California, was evacuated, hospital employees, fire personnel, and visitors loaded patients in any available vehicle, in addition to local ambulances, because the ambulance strike teams could not reach the hospital in time.

Getting Services to Vulnerable Populations

After a wildfire, many low-wage workers do not have access to unemployment or other safety net programs. Schools may be closed for weeks, which means that children in need of food do not get free breakfasts or lunches. Domestic workers and service workers can lose their jobs after their workplaces are destroyed. Landslides and closed roads can make it extremely difficult for some people to get to their jobs. In the case of a 2017 fire in Ventura and Santa Barbara counties: "To go to Santa Paula, a city about 60 miles northwest of Los Angeles, you can take the airplane into Santa Barbara Airport or you can take the ferry [to Santa Barbara], but the ferry was $30. Again, folks are left without viable modes of transportation," explained Genevieve Flores-Haro, director of the Mixteco–Indigena Community Organizing Project. One of several policy changes she noted that could improve preparedness, response, and recovery included infrastructure for transportation.

Studies of Wildfire Effects

The National Institute of Environmental Health Sciences of the National Institutes of Health has a mechanism for time-sensitive research, which Irva Hertz-Picciotto, director of the UC Davis Environmental Health Sciences Center and a professor of public health sciences at the UC Davis School of Medicine, and colleagues used to examine effects associated with the fires. These effects, which included exposures, health impacts, and needs, were studied using an online survey, a study of a cohort of pregnant women and mothers and their children, and a door-to-door survey.

The study found that respondents reported a wide variety of needs both immediately and one week after the fire, including transitional housing, clothing, safe drinking water, medicine, cell phone service, electricity, heat, hot water, sleep, breathing masks, and transportation.

Connecting Emergency Management with Human Services

The Administration for Children and Families (ACF) in the Department of Health and Human Services serves communities and families that are at crisis or live in crisis every day. According to Bryon Mason, Deputy Director of ACF, the office partners with the Federal Emergency Management Agency when there is a major disaster declaration under the Stafford Act. This federal law brings federal natural disaster assistance for state and local governments in carrying out their responsibilities to aid citizens.

One of the resources deployed by the Stafford Act is the immediate disaster case management program. The intent of the program is to connect disaster survivors to resources, whether faith-based, nongovernmental, state, local, or federal. In

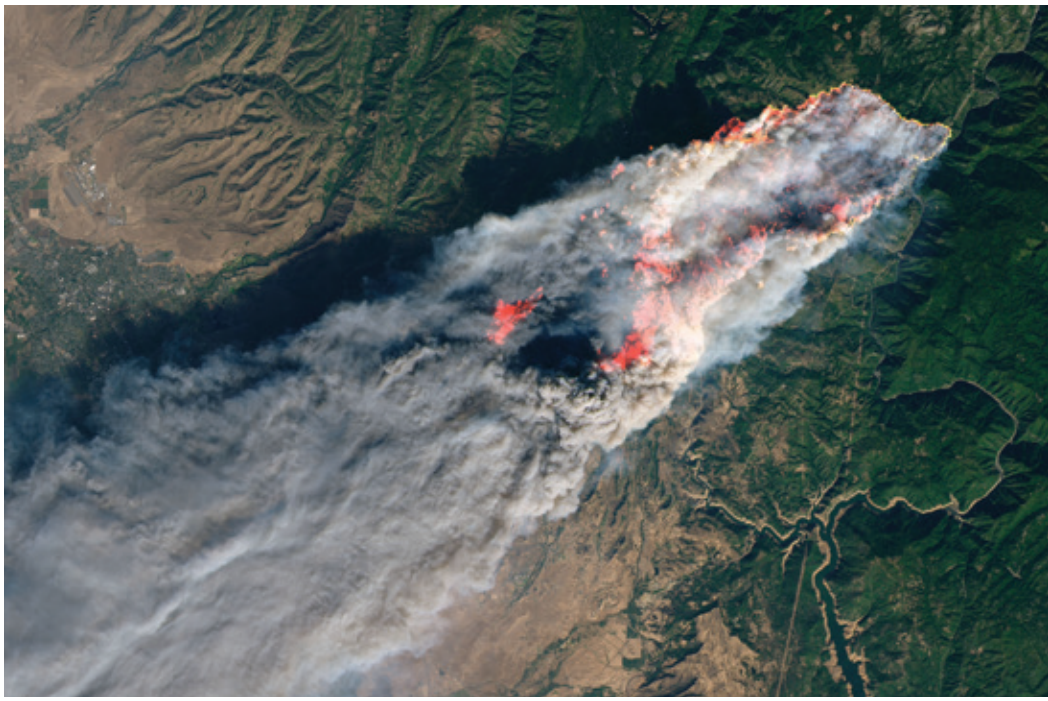


Photo: Joshua Stevens/NASA Earth Observatory

The 2018 Camp Fire in northern California forced a massive evacuation of the surrounding area.

Photo: Eddie Siguenza/U.S. Army National Guard

U.S. Army National Guard servicemembers prepare to assist evacuees at a recreation center in Petaluma, California, during the October 2017 wildfires.

the case of the Camp Fire, for example, Mason's office had interacted with more than 6,000 survivors by the time of the workshop, connecting them with resources like food, housing, clothing, and transportation.

Hertz-Picciotto pointed to major efforts to develop skills in people who are not mental health professionals for dealing with people who have mental health symptoms because of the traumas they have experienced in the counties affected by wildfires in California.

For example, many of the people who evacuated during a 2017 fire in Napa and Sonoma counties were driving through flames on both sides of their cars and worrying that their tires were going to catch fire or melt. "There's not a lot of roads going in and out of some of those towns in Napa and Sonoma, and they're not very wide. Some people were on the road for hours hoping that they were not going to get trapped in their car. The degree of trauma was enormous," Hertz-Picciotto noted.

Burn-Disaster Response

According to Dai et al. (*2*), the frequency of burn disasters rose substantially between the years 1990 and 2000 and the years 2001 and 2015. National disaster austerity guidelines outline what people can do if they face a shortage of burn supplies. Disaster triage tables provide guidelines for immediate care, triage algorithms, and acute transportation guidelines. The result has been substantial progress in communications networks with funding for disaster preparedness, equipment, local infrastructure, and education for providers, observed Tina Palmieri, assistant chief of burn surgery at Shriners Hospital for Children of Northern California and director of the UC Davis Regional Burn Center. Even as the number of disasters in the world has increased, she noted, the number of reported deaths has declined.

Conclusion

The increasing incidence of wildfires, especially in the western half of the United States, poses many challenges to communities. Multifaceted responses at the local, state, and federal levels are necessary to ensure that communities' needs are met in the short term—immediately after the fire—and in the longer term, which can often be years after the fire. Along with needs related to aspects of the environment, rebuilding communities, public health, and emergency preparedness, addressing transportation and infrastructure-related issues is key to helping to prevent future wildfires, fighting them while they are happening, and rebuilding communities and people's lives after the fires.

REFERENCES

1. Fothergill, A., E. G. Maestas, and J. D. Darlington. Race, Ethnicity and Disasters in the United States: A Review of the Literature. *Disasters*, Vol. 23, No. 2, 1999, pp. 156–173.
2. Dai, A., G. J. Carrougher, S. P. Mandell, G. Fudem, N. S. Gibran, and T. N. Pham. Review of Recent Large-Scale Burn Disasters Worldwide in Comparison to Preparedness Guidelines. *Journal of Burn Care and Research*, Vol. 38, No. 1, 2017, pp. 36–44.

MaaS Ready

International Study Mission for Mobility-as-a-Service

Photo: GPA Photo Archives, Flickr

PETRA MOLLET AND KATHERINE KORTUM

Mollet is Vice President of Strategic and International Programs, American Public Transportation Association, Washington, D.C., and Kortum is Senior Program Officer, Transportation Research Board, National Academies of Sciences, Engineering, and Medicine, Washington, D.C.

Above: Study mission participants met with public- and private-sector representatives in three European cities.

What does it mean to be mobility-as-a-service (MaaS)–ready? In June 2019, an American Public Transportation Association (APTA) study mission set off to Europe to find out. The 29 representatives from public transportation authorities and private organizations visited Vienna, Austria; Hamburg, Germany; and Helsinki, Finland. Each city has taken a different approach to integrating new mobility services, but each is now a global leader in developing the MaaS concept in practice. The cities aim to offer a full range of mobility options in a single digital platform that uses public transportation as the network backbone.

For APTA's purposes, MaaS can be defined as the integration of a full range of mobility options in one single digital mobility platform offering, with public transportation as the backbone. Users may choose the most suitable solution based on their travel needs. MaaS is available anytime and offers integrated planning, booking, and payment, and real-time travel information to provide easy mobility and alternatives to the single-occupant automobile. It provides comprehensive access to mobility services, including public transportation, ridesharing, carsharing, bikesharing, scooter-sharing, taxi, car rental, and ride-hailing.

Study Process and Questions

The delegation included senior representatives from public transportation agencies and from large and small businesses from across the United States. Throughout the week, study mission members participated in presentations, panel discussions, and site visits with the three cities' public transportation authorities, as well as local and national MaaS stakeholders from the public and private sector.

The study participants began the mission in Vienna, meeting with the public transportation operator Wiener Linien. Participants also met with representatives from Upstream, the public startup

Map of places visited.

MaaS platform that facilitates planning, payment, and access to mobility services throughout the Vienna region.

Study participants then continued on to Hamburg, hosted by bus and heavy rail operator Hamburger Hochbahn. Participants also heard from ÜSTRA, a Hannover agency that successfully transformed itself from a public transportation operator to a mobility management company.

The study mission ended in Helsinki where, in October 2016, MaaS Global had been the first private company to develop a MaaS subscription service through its Whim app. In the app, customers can arrange for all of their travel needs, either by buying individual tickets as needed or by purchasing a monthly subscription that provides access to transit, taxis, bikesharing, and carsharing services. Study participants met with MaaS Global and Demos Helsinki, a Nordic think tank, as well as with a variety of national and regional public actors. These included the Finnish Association of Public Transportation; the Helsinki Public Transportation Authority, which plans and organizes public transportation in the region; and the Finnish Ministry of Transportation, to learn about the legislative approaches that have made Finland a global MaaS leader.

The study mission addressed a number of critical questions, including the following:

- What customer-facing strategies do these public transportation agencies use to build a MaaS platform that includes trip planning and ticketing for all mobility options?
- Who is—and should be—taking the lead?
- What partnerships are required?
- What are the most viable business models?
- How can the physical mobility system be integrated more effectively, allowing for seamless transfers between modes?

The study mission underscored the importance of positioning transit as the foundation of the MaaS concept. A clear vision of sustainable mobility, an excellent and well-integrated public transportation system, and mobility partners willing to coordinate on a level playing field all are necessary ingredients of a successful MaaS system.

Participants noted that each of the cities they visited already has a very well-developed transit system with a high modal share of local and regional trips. Yet these cities continue to invest in organizational and system innovations to provide the best possible customer experience and to remain a relevant mobility player in the future.

Key Findings

WORKING TOWARD GOALS

Transportation agencies of all modes must connect MaaS to a broader set of regional goals. These European systems see MaaS as a strategy for addressing issues such as healthy cities, strong regional economies, improved air quality and environment, reduced carbon emissions, and equity and access for all. MaaS is a way to capitalize on the full array of mobility options to reduce reliance on single-occupant vehicles and private car ownership. That is the end game—not MaaS itself.

In Vienna, the official city strategy is to lower the mode share of private cars to just 20% by 2025. Hamburg has an equally ambitious goal of reducing single-occupancy vehicle trips, and Finland's nationwide goal is to halve emissions by 2030, which will require a decrease in individual car trips. In all three countries, climate change concerns are the consistent driver behind the implementation of MaaS initiatives.

STRONG FOUNDATIONS

It was clear from all cities visited that **a digital multimodal mobility platform must be built on a robust and well-integrated transportation system**. Many of the systems are developing the concept of "mobility hubs" as an important element of their MaaS strategy. These cities have also focused on a structured entry of transportation network companies (e.g., Uber, Lyft, and others) and micromobility options (e.g., bikeshare, e-scooters, and the like) to afford time to think through their place in the mobility system.

TRANSIT AS THE BACKBONE

European transit agencies are of the collective mindset that **public transportation must be the backbone of integrated mobility services** in an era driven by new customer expectations, new technologies, and new mobility options. Both private- and public-sector entities look to MaaS to position themselves as the platform and integrator of mobility; however, the public sector—including transportation agencies—is in the best position to look out for the public good, offer a complete mobility solution, and reduce the hassle for customers of finding the most suitable travel option for each trip.

Transit agencies should be actively involved in MaaS development, implementation, and management, whether as a collaborator, enabler, or manager. As Martin Röhrleef of ÜSTRA noted, "Uber yourself before you get Kodaked."

CHALLENGE OF GOVERNANCE

Governance, not technology, is the key challenge for MaaS. Although every region takes a unique approach, each of the three cities studied have faced and addressed questions of how to organize to

Photo: moovit

Hamburger Hochbahn bus route 39 in Hamburg, Germany. The city has a goal of reducing single-occupancy vehicle trips.

implement MaaS, as well as questions of what institutional and regulatory frameworks are required. MaaS looks different in each city, but all transit agencies have taken a central role and worked closely with local governments to ensure overall policy alignment. In North America, it is vital to do the same.

LEVERAGING ASSETS

To take a central role in mobility service integration and in a MaaS platform, **transit agencies must leverage their own unique infrastructure, assets, and data** and must understand technology to make appropriate decisions that drive innovation. This means expanding the skill sets available in the transit workforce, including hiring more software developers and data scientists.

MaaS is a new business approach requiring a transformation of organizational cultures to allow agencies and their employees to innovate and experiment. Several of the established European transportation agencies defined risk as "what happens if we do nothing." They cultivate and reward risk-taking internally and give riders credit for trying and liking something.

GOAL OF EQUITY

MaaS can revolutionize the customer experience and can individualize the mass transportation and shared mobility experience. It can expand mobility service coverage and reach, increasing access to the mobility system. But equitable access to a sustainable mobility system must be the ultimate goal—not MaaS itself.

Conclusion

These findings are consistent with the study mission delegation's collective experience in the United States and Canada. The fundamental difference with Europe, however, is the greater role that public transportation plays in serving the public. It generally is widely acknowledged in Europe that transit agencies should lead the integration of urban and regional transportation options.

In North America, there is more work to be done in convincing local decision makers that the transit agency should be at the center of a MaaS-oriented system and in ensuring that agencies are prepared to do so.

This article is a brief summary of the APTA report "Being Mobility-as-a-Service (MaaS) Ready," released at the APTA TransFORM conference in New York in October 2019. The full report is available at www.apta.com/wp-content/uploads/MaaS_European_Study_Mission-Final-Report_10-2019.pdf.

Stacey G. Bricka

MacroSys

Travel behavior data—and their collection, interpretation, and deployment—are the core of **Stacey G. Bricka's** career. "In working with transportation agencies to design surveys that collect the data they need, we have tested new technologies, new methods, and different approaches," she comments.

Bricka focuses on helping agencies update, refresh, and transition their travel behavior data programs. For some agencies, travel behavior surveys are conducted once every decade or so, and their current interest is to enhance their data programs with passive data products; others need more real-time behavioral data—both passive and survey data—and seek to transition to more frequent data-collection cycles. She has managed or directed more than 100 surveys pertaining to travel behavior and transportation and has advised agencies—from the U.S. Department of Transportation (DOT) to state, regional, and local planning agencies—on various methodological and technological aspects of designing large-scale regional and statewide travel surveys and leveraging passive data products and new software tools.

"Most agencies want to understand emerging mobility trends better and how those trends might best be reflected in the planning process," Bricka notes. "I see my role as helping agencies identify their data priorities, understand the trade-offs, and identify improvements to strengthen their transportation data programs."

"Travel behavior data are a small but important piece of the transportation planning puzzle," Bricka observes, noting that these data are used to develop or update travel demand models; inform policy questions; and provide insights into who travels where, when, and for what purposes. Data programs are not one-size-fits-all, since each agency uses data differently and faces different budget constraints.

Bricka received bachelor's and master's degrees in economics from Eckerd College and the University of South Florida, respectively, and a Ph.D. from the University of Texas at Austin. She started at PTV NuStats as research manager in 1994 and then rose through the ranks to vice president. In 2010, she joined Texas A&M Transportation Institute as research scientist and began working at MacroSys in 2016 as senior research scientist.

"Most agencies want to understand emerging mobility trends better and how those trends might best be reflected in the planning process."

Bricka first attended the Transportation Research Board (TRB) Annual Meeting in 1992, and her first committee appointment to the committee on Urban Data and Information Systems was in 1999. In 2011, she helped form the Task Force on Understanding New Directions for the National Household Travel Survey and served as its chair. She is outgoing chair of the Standing Committee on Urban Transportation Data and Information Systems. She is a member of the standing committees on Travel Survey Methods and on Transportation Planning Applications, where she also co-chairs the subcommittee on Household Travel Surveys. "The collaborative nature of TRB, through committees, annual meeting events, and the regional conferences, is crucial for providing venues for dialogue, presentation of case studies, and bringing the community together to solve challenges and identify the path forward," she notes.

"Through my involvement with TRB, I've had the opportunity to compare notes on innovations and lessons learned (particularly what did not work) and to celebrate successes with others working in this field, ultimately resulting in advancements in the state of the practice for travel surveys," Bricka affirms. Some of her favorite projects and activities have involved developing conferences, particularly the 2008 Tools of the Trade Conference, working with the Standing Committee on Transportation Planning for Small- and Medium-Sized Communities, and a symposium on the future of household travel surveys in the United States, funded by the Southwest University Transportation Center in 2012. She is currently on the planning committees for the 2020 Innovations in Travel Modeling and the 2020 International Travel Survey conferences.

"It is an exciting time to be involved in transportation research—emerging technologies result in new mobility opportunities and generate passive data that can be leveraged to provide fresh insights into daily travel patterns and potentially alleviate respondent burden associated with traditional surveys," Bricka comments, adding that it is essential to continue dialogue about what is and is not working well, as well to facilitate standard reporting of results to allow comparability across methods and technologies. "Providing a forum for open dialogue about what not to do, as we have at TRB, is as critical in moving the practice forward as presenting what did work—especially as we're looking at leveraging complementary data sources."

Bouzid Choubane

Florida Department of Transportation

Bouzid Choubane has been actively involved in pavements- and materials-related areas and technologies for more than 30 years. He currently serves as State Pavement Materials Engineer for the Florida Department of Transportation (DOT). In this role, he provides leadership, strategic direction, and oversight for pavement-related work and research programs, and builds strategic partnerships to implement multimillion-dollar work and research programs for ensuring safe and durable pavement systems. Choubane previously served as the interim director of the Florida DOT Office of Materials and is a courtesy professor at the University of Florida Department of Civil and Coastal Engineering.

Before joining Florida DOT, Choubane was a research associate with the National Research Council of Canada. He earned his master's degree from the University of Pennsylvania and his Ph.D. from the University of Florida. He is a registered Professional Engineer in the state of Florida.

Choubane has built a reputation on the importance of adequately characterizing the performance and condition of roadway pavements, and this continues to be one of his core interests. "As travel safety and efficiency increase in importance to state agencies, pavement infrastructure performance evaluation techniques and resulting measurements have become a crucial tool in the management of pavement systems," Choubane notes.

Ultimately, these measurements are quintessential to the efforts to support informed planning, policy, and decision making at national, state, and local levels. An important focus is safe, appropriate, and effective pavement testing approaches, facilitated by new technologies, he notes: "Advances in sensor and inertial navigation technologies are providing for significant enhancement to their functionality. As a pavement engineer, one of my strategic objectives has been to seek safer testing technologies and innovative practices that provide for effectiveness, versatility, ease, and speed of use, minimizing adverse impact on road users. Such evaluation methodologies would allow us to capitalize on the large amount of valuable information that can be offered by the state-of-the art equipment."

Choubane points to a few highlights of his tenure at Florida DOT, where he has worked to leverage research and technological advances to implement new initiatives and statewide programs to support the agency's mission to provide a safe and efficient transportation system.

"I believe that research is critical to the advancement of the state of knowledge and the state of the practice."

For instance, the planning and implementation of an accelerated pavement testing (APT) and research program. This program was initiated to address the need for faster, safer, and more practical evaluation methods under closely simulated in-service conditions that laboratory testing alone could not provide. The APT program has become a critical component of Florida DOT's pavement research program.

Choubane also headed up the development and implementation of a new Pavement Marking Management System for an efficient and less-subjective methodology to monitor the safety and night visibility of the Florida roadway system. The program was highlighted in a recent Research Pays Off article in *TR News*.

"We currently face formidable challenges to renew and sustain our transportation infrastructures to meet the demands of a growing population—but with the added new reality that technologies are disrupting the current way we plan, design, build, and use transportation infrastructures," Choubane observes.

"Pavements occupy valuable real estate," he points out, citing a recent TRB Annual Meeting workshop on smart and multifunctional pavements. "Technological innovations provide forward-looking and futuristic opportunities for designing and constructing multifunctional, multipurpose pavements that go beyond their traditional purpose of carrying traffic loads." He adds that close collaboration with academic institutions, industry, and other transportation agencies and associations, based on joint strategic planning and well-defined objectives, is imperative.

Choubane has been active in TRB since the early 1990s. He has chaired or served as a member of more than 20 TRB committees, sections, groups, panels, and task forces. He is the current chair of the Pavements Section.

"I believe that research is critical to the advancement of the state of knowledge and the state of the practice. I also believe that synergistic strategic partnerships are a key mechanism for supporting research," Choubane observes. "This is necessary to assemble an adequate, diversified, and multidisciplinary capacity pool and needed resources to pursue new and innovative technologies."

Choubane has received several recognition awards, including the Outstanding Teaching and President's Recognition awards from the University of Florida, the Meyer-Horne Outstanding Achievement Award from ASTM International, and the Florida DOT Highway Engineering Award. He authored or coauthored more than 80 peer-reviewed technical papers and served as the editor for two special technical publications.

INFLUENCERS

Matthew Beamer

Matt Beamer is Senior Professional, Cambridge Systematics, Inc. He is a member of the TRB Young Members Council, the Standing Committee on Aviation Economics and Forecasting, and the Aviation Group.

"Transportation Influencers" is a new section in *TR News*, highlighting the journey of young professionals active in TRB. Have someone to nominate? Send an e-mail to TRNews@nas.edu.

How did you first hear about or become involved in TRB?
I first heard about TRB while in graduate school for transportation engineering, but I didn't become involved until I was asked to join the Young Members Council—Aviation by an alumna of my program, Elaine McKenzie, who was the chair at the time.

How has TRB informed your career so far?
TRB has given me the opportunity to meet people working on all aspects of transportation. They have led me to resources to help on projects that are not constrained to my particular field, allowing me the opportunity to work on high-visibility, meaningful projects in my companies.

Any tips for new transportation professionals or students about to go into the field?
I would encourage any new transportation professionals or students to keep an open mind and stay curious. Keep learning and opportunities will come.

MEMBERS *ON THE MOVE*

Pamela Keidel-Adams, Kimley-Horn and Associates, Inc., has been appointed chair of the TRB Aviation Group. She previously was chair of the Standing Committee on Intergovernmental Relations in Aviation.

Reynold King Watkins was recently honored by the Standing Committee on Subsurface Soil–Structure Interactions for his contributions to the industry and TRB—on his 100th birthday, which was in January. He chaired several geotechnical TRB committees in the 1960s and 1970s.

Travis McGrath left Idaho Transportation Department, where he was chief operations officer and enterprise risk manager, to enter private practice. He is a member of the National Cooperative Highway Research Program Project Panel on Scoping Study to Develop the Basis for a Highway Standard to Conduct an All-Hazards Risk and Resilience Analysis.

Anand J. Puppala, chair of the TRB Geotechnical Engineering Section, left the University of Texas at Arlington to accept the A.P. & Florence Wiley Chair position at Texas A&M University.

Roy Sturgill, chair of the Standing Committee on Utilities, has joined Iowa State University's College of Engineering as an assistant professor of civil, construction, and environmental engineering. Previously, he worked as a research engineer at the Kentucky Transportation Center at the University of Kentucky.

To share career or committee changes and milestones to the "Members on the Move" section, send an e-mail to TRNews@nas.edu.

In Memoriam

Longtime TRB volunteer **Tom Brigham** died in June 2019 in Anchorage, Alaska. He was active in several committees, most recently the Standing Committee on Transportation Programming and Investment Decision Making, and mentored several volunteers throughout their careers—several of whom went on to become committee chairs. He was Pacific Northwest regional transportation planner at HDR.

Roundabout Renaissance

BETH EWOLDSEN

The author is Content Strategist, Transportation Research Board, Washington, D.C.

Driving down a calm country road through scenic green fields dotted with sheep, you come to a roundabout, slow down to check oncoming traffic, then gently swerve around before continuing on your way. Are you exploring merry old England or New England?

Many modern drivers may be surprised to learn that American William Phelps Eno is credited with first designing and implementing the roundabout. We know his 1905 invention as Columbus Circle in New York, although it is considered a traffic circle rather than a roundabout in its current iteration. During the 1950s, however, roundabouts fell out of favor in the United States. It wasn't just the era of large cars and a love of the open road that made the intersections unpopular. Until the United Kingdom developed standardized rules in the 1960s for using roundabouts, they were considerably more dangerous than they are today.[1]

The reemergence of roundabouts still feels relatively new here, but as users become more comfortable with them, the rounded intersections are coming back in fashion. By the late 1990s, only nine state agencies reported a roundabout in operation. That number grew to 38 states by 2016.[2]

ROUNDABOUT RESEARCH AT TRB

TRB has convened experts and synthesized research on roundabouts since 1997.[3] At that time, only 50 were known to have been constructed since the start of the decade. Within another decade, that number had grown to more than 4,000.[4] *National Cooperative Highway Research Program (NCHRP) Report 672*, published in 2010, now is widely used, with most reporting state agencies quoting it for design guidance in 2016.

ROUNDABOUT REVOLUTION

What kicked off this rediscovered love of roundabouts? Are they a passing fad, slowly making their way across the country, destined only to disappear again? Originally, roundabouts were an innovative way to keep traffic moving rather than coming to a standstill at four-way intersections.

Local traffic planners now see safety as their main benefit, although they may also be a less-expensive option than other measures or a way to make better use of space. Although their existence doesn't automatically lead to lower average speeds, roundabouts are effective in improving speed-limit compliance by 15–20%, even at the end of the transition area.[5] Rounded intersections, particularly those with only one lane in each direction, reduce the complex decisions that drivers, pedestrians, and cyclists must make in navigating traffic, leading to fewer accidents and less-severe injuries when accidents do happen.

A modern roundabout is a generally circular intersection with traffic moving counter-clockwise around a central island.[6] The rules as established in the 1960s require that entering traffic yields to traffic already in the circle. Roundabouts can be as small as two lanes or span more than eight lanes of traffic. Local transportation departments are happy to show you how to use one with videos on YouTube, since most drivers are skeptical or intimidated before trying it out for themselves.[7] In addition to traffic safety, the Nevada Department of Transportation, which helped start the renaissance in 1990 with its Las Vegas roundabouts, notes their aesthetic appeal.[8]

BROADER IMPLICATIONS

Once roundabouts began to make a reappearance in modern American road design, research highlighted further opportunities for improvement. As their usage has increased, roundabouts have been included

[1] For more on Eno and the history of roundabouts, see *NCHRP Report 672: Roundabouts—An Informational Guide, Second Edition*, at www.nap.edu/read/22914.

[2] For more, see *NCHRP Synthesis 488: Roundabout Practices*, at www.nap.edu/read/23477.

[3] For more, see *NCHRP Synthesis 264: Modern Roundabout Practice in the United States*, at http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_264.pdf.

[4] To see a snapshot of roundabout location data in the United States, visit http://roundabout.kittelson.com/pdf/Rodegerdts—Status of Roundabouts in North America 2017.pdf.

[5] For more, see *NCHRP Report 737: Design Guidance for High-Speed to Low-Speed Transitions Zones for Rural Highways*, at www.nap.edu/read/22670.

[6] For more, see *NCHRP Research Report 900: Guide for the Analysis of Multimodal Corridor Access Management*, at www.nap.edu/read/25342.

[7] An example video can be found at www.youtube.com/watch?v=ONacAiKXe-8.

[8] For example, this Nevada DOT brochure: www.nevadadot.com/home/showdocument?id=108.

Photo: Dan Burden/pedbikeimages.org

Roundabouts can range from two lanes to more than eight lanes of traffic.

in analysis of larger issues, like traffic noise or techniques for corridor access across a range of vehicles.[9] State transportation agencies have begun to document standard procedures for how to handle temporary traffic control for lane closures in roundabouts during roadwork.[10] Certain types of intersections lend themselves better to roundabouts than others. By 2016, many case studies explored the installation costs in terms of safety, time, construction, and illumination.[11]

The Federal Highway Administration has made a significant effort to unify and standardize efforts around roundabouts. They now use this work as an example of how to successfully measure return on investment within projects.[12] When they are constructed, roundabouts are planned to last in place for 10 to 20 years.

Despite their use for improved safety, there are still additional protection measures to keep in mind. A well-known concern is the danger of crosswalks with no signals for pedestrians who are blind or have vision impairment. By 2017, TRB documented methodology for designers to complete a crosswalk assessment for this specific group of pedestrians.[13] Senior American drivers have a longer history of driving without having to use roundabouts. They may be especially hesitant in embracing the design, but after about a year, older drivers favor roundabouts and often benefit the most from the safety features.[14]

Photo: Washington State DOT

Pedestrian safety at roundabouts, particularly for vulnerable populations, is a topic of further research.

More than 20 years since roundabouts reappeared, America's safety-minded authorities and busy commuters finally seem to be embracing Eno's invention.

KEEP IT MOVING

The most recent TRB analysis on roundabouts focused on their use in crash-prediction models and methods.[15] Via an examination of many factors in the modern roundabout, the report recommends scientific methods for calibrating models for confident predictions in roundabouts at every level, from design planning to individual leg decisions. Designing roundabouts with more lanes than needed actually can degrade safety performance. Higher posted speed limits are, predictably, related to crash severity.

Unsurprisingly, TRB is already looking ahead. Further research is needed on pedestrian and bicycle safety at roundabouts as well as the relationship between drivers' speed and ability to predict the frequency and severity of crashes. An update to the 2010 guide is in process. Several sessions at the 2020 TRB Annual Meeting covered roundabouts—their design, implementation, surfaces, and safety for cyclists and pedestrians. The topic remains one of the most popular on TRB's website, reflecting an ongoing interest in research in the field.

Cooperative Research Programs News

TRB Launches New Website for *Selected Studies in Transportation Law*

TRB recently launched a new website for its *Selected Studies in Transportation Law* (SSTL) collection: https://crp.trb.org/selected-studies-law. This website is fully responsive and has enhanced search capabilities.

Published jointly by NCHRP and the Transit Cooperative Research Program,

[9] For more, see NCHRP Report 791: *Supplemental Guidance on the Application of FHWA's Traffic Noise Model*, at www.nap.edu/read/22284.
[10] For more, see *NCHRP Synthesis 525: Practices in One-Lane Traffic Control on a Two-Lane Rural Highway*, at www.nap.edu/read/25174.
[11] For more, see *NCHRP Web-Only Document 220: Estimating the Life-Cycle Cost of Intersection Designs*, at www.nap.edu/read/21928.
[12] A 2013 letter report from the Research and Technology Coordination Committee to FHWA describes this in greater detail; for more, see http://onlinepubs.trb.org/onlinepubs/reports/rtcc_july_2013.pdf.
[13] For more, see *NCHRP Research Report 834: Crossing Solutions at Roundabouts and Channelized Turn Lanes for Pedestrians with Vision Disabilities: A Guidebook*, at www.nap.edu/read/24678.
[14] See the Insurance Institute for Highway Safety's Roundabouts webpage for more information: www.iihs.org/topics/roundabouts#effect-on-older-drivers.
[15] For more, see *NCHRP Research Report 888: Development of Roundabout Crash Prediction Models and Methods*, at www.nap.edu/read/25360.

this collection is designed to help state highway departments and public transportation agencies keep abreast of operating practices and legal elements of specific problems in highway and transit law. SSTL may be of particular interest and value to new legal staff entering the field of transportation law and can serve as a refresher for senior legal staff.

The SSTL collection was originally presented in CD-ROM format, but as technology changed, a web-accessible version of the material was needed. The SSTL WebResource provides access to the original eight volumes of the series, including *Construction Contract Law, Eminent Domain, Environmental Law and Transportation, Tort Liability of Highway Agencies, Transit Law, Transit Labor 13(c) Decisions, Transit Charter Bus Service: Decisions and Documents*, and *Transportation Law and Government Relations*, as well as six recent updates of selected material. Individuals can download these volumes in their entirety or can download sections of a particular title.

A video outlining the award-winning *NCHRP Research Report 905* toolkit can be viewed at https://vimeo.com/prr/review/352147202/cee4a9be9a.

Award-Winning Research on Measuring the Effectiveness of Public Involvement

NCHRP RESEARCH REPORT 905

Although many resources examine how best to conduct public involvement, few practical or validated methods are available to help gauge the effectiveness of public involvement. *NCHRP Research Report 905: Measuring the Effectiveness of Public Involvement in Transportation Planning and Project Development* is an innovative toolkit for practitioners that addresses this need. In fall of 2019, the International Association of Public Participation (IAP2) honored the *NCHRP Research Report 905* team, PRR, Inc., of Seattle, Washington, with international and national Core Values Awards. In the award citation, IAP2 noted the study's methodology and its focus on measurement.

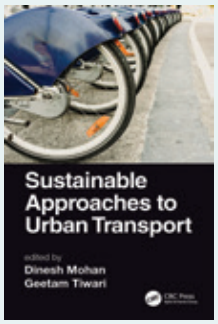
The goal of the NCHRP project was to create a method to validly measure the effectiveness of public involvement, while being user-friendly and "doable" given the typical constraints faced by agencies. The study included a systematic literature review, development of indicators for measuring the effectiveness of public involvement, and creation of items to measure each indicator. The research team then translated the items into a survey instrument for use in collecting information from participants in public involvement activities. A related survey instrument was designed for transportation agency staff to enable the comparison of feedback from participants with the agency's own perceptions.

Recognizing the importance of usability, the surveys were field-tested at public involvement events for two infrastructure projects and a transportation planning effort, in partnership with Washington State Department of Transportation (DOT). The research team then used rigorous methods to develop a scoring tool that calculates effectiveness scores from the survey responses. The tool calculates scores for each indicator, as well as an overall effectiveness index. The field tests provided valuable insights and practical tips on how to implement the survey and the scoring tool.

The toolkit enables agency professionals to track performance throughout the project life-cycle, identify strengths and weaknesses of public involvement activities, and inform decisions about the best way to allocate resources. In addition, the use of the surveys can serve to improve relationships with affected communities since they now have a means for providing feedback not only on projects but also on the public involvement processes. Finally, the use of the toolkit allows agencies to demonstrate the seriousness with which they take their responsibilities to conduct effective public involvement.

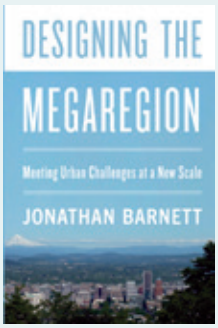
The toolkit includes paper and online versions of the survey for use with the public, an online version of the survey for use by the public involvement agency, an Excel scoring tool, and guidelines for administering and scoring the surveys. The toolkit and *NCHRP Research Report 905*, which provides background information and details of the development of the toolkit, are available at www.trb.org/Main/Blurbs/179069.aspx.

State DOTs interested in using the toolkit may apply for NCHRP implementation support funds to do so. More information on this program is available at www.trb.org/NCHRP/NCHRPImplementationSupportProgram.aspx.



Sustainable Approaches to Urban Transport
Edited by Dinesh Mohan and Geetam Tiwari. CRC Press, 2020; 299 pp,; $179.95; 978-1-138-54423-9.

As cities become increasingly congested, current transportation patterns become unsustainable. Effective urban planning develops human-scale cities and requires good engineering design to manage road use. *Sustainable Approaches to Urban Transport* brings together contributions from leading international experts in urban planning, transportation, and governance who suggest changes to make cities more sustainable in the face of climate change.



Designing the Megaregion: Meeting Urban Challenges at a New Scale
Jonathan Barnett. Island Press, 2020; 184 pp.; $30; 978-1-642-83043-9.

Designing the Megaregion presents key design and development initiatives to help reduce the pressure megaregions place on transportation systems, natural resources, and housing equity. Architect and planner Jonathan Barnett offers suggestions for how to begin incremental design work now using both private investment and existing administrative structures.

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

TRB PUBLICATIONS

Transportation Research Record 2673 Issue 5

Authors present research on a travel demand model approach to examining the equity impacts of autonomous vehicles, individual truck speed estimation from advanced single inductive loops, probabilistic life-cycle cost analysis of pavements based on simulation optimization, and other topics.
2019; 778 pp. For more information, visit http://journals.sagepub.com/home/trr.

Transportation Research Record 2673 Issue 6

Topics explored in this volume include driver back-tracing based on automated vehicle identification data, seasonal and long-term changes to pavement life caused by rising temperatures from climate change, and utilization of state performance indices to correlate national performance measures for asphalt pavements in Tennessee.
2019; 684 pp. For more information, visit http://journals.sagepub.com/home/trr.

Transportation Research Record 2673 Issue 7

The effects of travel time reliability and commodity characteristics on hinterland leg transportation of export containers, a Bayesian survival approach to analyzing the risk of recurrent rail defects, and a synthetic origin–destination approach to constructing a network fundamental diagram are a few of the topics presented in this volume.
2019; 721 pp. For more information, visit http://journals.sagepub.com/home/trr.

SAGE is now the publisher of the *Transportation Research Record: Journal of the Transportation Research Board (TRR) series. To search for TRR articles, visit http://journals.sagepub.com/home/trr. To subscribe to the TRR, visit https://us.sagepub.com/en-us/nam/transportation-research-record/journal203503#subscribe.*

Leveraging Big Data to Improve Traffic Incident Management NCHRP Research Report 904

This report illuminates big data concepts, applications, and analyses; describes current and emerging sources of data that could improve traffic incident management (TIM), describes potential opportunities for TIM agencies to leverage big data, identifies potential challenges associated with the use of big data, and develops guidelines to help advance the state of the practice for TIM agencies.
2019; 202 pp.; TRB affiliates, $69.75;

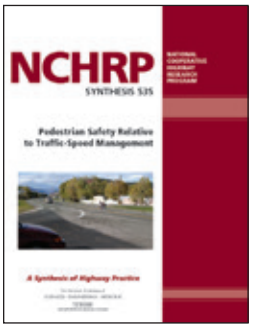
nonaffiliates, $93. Subscriber categories: highways, operations and traffic management, security and emergencies.

Relationship Between Erodibility and Properties of Soils
NCHRP Research Report 915

This report provides reliable and simple equations to quantify the erodibility of soils on the basis of soil properties. Analysis of the erodibility of geomaterials is important for the study of problems related to soil erosion: bridge scour, embankment overtopping erosion, and stream stability.
2019; 336 pp.; TRB affiliates, $83.25; nonaffiliates, $111. Subscriber categories: bridges and other structures, geotechnology.

Sustainable Highway Construction Guidebook
NCHRP Research Report 916

This report provides clear and practical information on what constitutes sustainability in the context of highway construction and how to evaluate any proposed construction practice for its sustainability potential. Offered are ways to explicitly advance sustainability in procurement and contracting and to develop a sustainability management plan for the construction phase.
2019; 248 pp.; TRB affiliates, $74.25; nonaffiliates, $99. Subscriber category: construction and environment.



Pedestrian Safety Relative to Traffic-Speed Management
NCHRP Synthesis 535

This synthesis documents strategies and countermeasures to address pedestrian safety via traffic-speed management in urban environments. The authors found there may be a need for greater clarity about the speed-limit-setting process, and for greater collaboration between local and state agencies when state roads run through urban areas.
2019; 122 pp.; TRB affiliates, $60; nonaffiliates, $80. Subscriber categories: highways, pedestrians and bicyclists, safety and human factors.

Transportation Workforce Planning and Development Strategies
NCHRP Synthesis 543

This synthesis presents the current state of practice associated with the implementation of transportation workforce planning and development strategies at state departments of transportation and associated local and tribal technical assistance programs.
2019; 68 pp.; TRB affiliates, $49.50; nonaffiliates, $66. Subscriber categories: administration and management, educational training, planning and forecasting.

Impacts of Policy-Induced Freight Modal Shifts
NCFRP Research Report 40

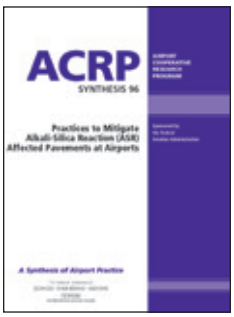
This report provides public policy makers with the factors that shippers and carriers consider when choosing freight modes and provides an analytical methodology to quantify the probability and outcomes of policy-induced modal shifts. This is the final report of the National Cooperative Freight Research Program, which ended on December 31, 2019.
2019; 194 pp.; TRB affiliates, $68.25; nonaffiliates, $91. Subscriber categories: freight transportation, planning and forecasting, motor carriers, railroads.

Air Demand in a Dynamic Competitive Context with the Automobile
ACRP Research Report 204

This report explores the potential effects of evolving automobile and aircraft technology and shifting consumer preferences on demand for shorter-range air trips. This volume is designed to help managers of smaller airports develop a better understanding of how consumers choose between flying out of a smaller, hometown airport to connect to a flight at a larger airport or taking a longer automobile drive to fly directly from the larger airport.
2019; 110 pp.; TRB affiliates, $57; nonaffiliates, $76. Subscriber categories: aviation, economics, planning and forecasting.

Guidebook on Effective Land Use Compatibility Planning Strategies for General Aviation Airports
ACRP Research Report 206

This report identifies that local adoption and implementation of airport land use compatibility regulations vary widely among local government agencies and help airport operators understand the various tools for ensuring compatible land use and how best to communicate land use compatibility needs to government decision makers and land use professionals, among other stakeholders.
2019; 150 pp.; TRB affiliates, $63.75; nonaffiliates, $85. Subscriber categories: aviation, planning and forecasting.



Practices to Mitigate Alkali–Silica Reaction (ASR)–Affected Pavements at Airports
ACRP Synthesis 96

This synthesis presents the current state of the practice regarding the mitigation measures used on existing ASR-affected airport pavements and summarizes the experiences and practices of airports in dealing with the issue.
2019; 94 pp.; TRB affiliates, $54; nonaffiliates, $72. Subscriber categories: aviation, maintenance and preservation, pavements.

How Airports Plan for Changing Aircraft Capacity: The Effects of Upgauging
ACRP Synthesis 97

A literature review, 18 surveys, and interviews with airport and transportation agency representatives are used in this volume to explore the effects of upgauging. *2019; 100 pp.; TRB affiliates, $54; nonaffiliates, $72. Subscriber categories: aviation, maintenance and preservation, planning and forecasting.*

Partnerships Between Transit Agencies and Transportation Network Companies (TNCs)
TCRP Research Report 204

This report presents findings pertaining to data and information requirements of transit agencies and TNCs, as well as the benefits, outcomes, and challenges of partnerships with these companies. *2019; 154 pp. Subscriber categories: public transportation, 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.

CENTENNIAL QUOTES

"As a mathematically and scientifically inclined individual, I have always had a passion for innovation and the strong will to pursue an epochal engineering career. Selected as a TRB Minority Student Fellow, I was guaranteed a slot to present my research work at the TRB Annual Meeting, a platform not only to showcase my writing and research but also to further develop these skills via the peer review process and critique from field professionals. The value of building relationships with like-minded individuals from diverse backgrounds and organizations is unmatched; I now feel more integrated in the transportation field. Most notably, I met my employer at this world-class event: I met one of the firm's associates at the Career Fair, who later introduced me to one of their principals. Talk about fate—we both marveled when we realized we were presenting our posters right across from each other during the same time slot."

—TINOTENDA JONGA
TRB Minority Student Fellow, Transportation Engineer/Planner I, Fehr & Peers

"In 2002, after completing undergraduate studies, driving my last mile as a truck driver, and marrying a flight attendant, I returned to graduate school in transportation policy operations and logistics at George Mason University. Once I attended the TRB Annual Meeting, my eyes were opened to a new, incredible world of transportation opportunities. I then found my current agency, the Federal Motor Carrier Safety Administration, in which I now regulate the industry I once worked in. If you ask me, I've come full circle! The Annual Meeting has always been a wealth of information and a networking platform to which I can turn for support."

—RICHARD JOHNSON
Highway Safety Specialist, Federal Motor Carrier Safety Administration

"The first time I attended the TRB Annual Meeting, as a graduate student, it was the year a major snowstorm descended on D.C., and I was fortunate to arrive on Saturday. I also was very fortunate to stay that first night with a friend who could loan me hiking boots, since the TRB shuttle buses weren't working for days. I've been to the Annual Meeting 24 times, and it never grows old. I find the Poster Room to be the most impactful for me now, as I marvel at mountains of new research, with valuable findings and conversations throughout."

—KARA KOCKELMAN
Professor of Transportation Engineering, University of Texas at Austin

MEETINGS

April

28–29 **Lead Emissions from Piston-Powered General Aviation Aircraft Committee Meeting**
Online
For more information, e-mail Michael Covington, TRB, at mcovington@nas.edu.

28–29 **U.S. Coast Guard Maritime Domain Awareness Study Committee Meeting**
Online
For more information, e-mail Michael Covington, TRB, at mcovington@nas.edu.

May

13 **TRB Shared/AV Forum Webinar**
Online
For more information, e-mail Michael Covington, TRB, at mcovington@nas.edu.

19–20 **Research and Technology Coordinating Committee Meeting**
Online
For more information, e-mail Michael Covington, TRB, at mcovington@nas.edu.

June

3–5 **Aviation Group Midyear Meetings: Environmental Impacts of Aviation Committee, Airfield and Airspace Capacity and Delay Committee, Aviation System Planning Committee, Intergovernmental Relations in Aviation Committee, and Aviation Group Executive Board**
Online
For more, visit http://bit.ly/TRBAVIATION2020.

3–6 **International Symposium on Pavement, Roadway, and Bridge Life Cycle Assessment 2020***
Sacramento, California

16–18 **Advancing the Marine Transportation System Through Automation and Autonomous Technologies: Trends, Applications and Challenges—6th Biennial Marine Transportation System Innovative Science and Technology Conference**
Washington, D.C.

23–24 **Aviation Group Midyear Meetings: Business Aviation Subcommittee, Plenary Economic Outlook Discussion, Commercial Airlines Subcommittee, and Helicopters Subcommittee**
Online
For more, visit http://bit.ly/TRBAVIATION2020.

28–July 2 **10th International Conference on Bridge Maintenance, Safety, and Management***
Sapporo, Japan

July

11–14 **13th National Conference on Transportation Asset Management**
Boston, Massachusetts

26–29 **Geospatial Data Acquisition Technologies in Design and Construction Committee Meeting**
Austin, Texas

26–31 **Joint Committee Meeting: TRB Roadside Safety Design and AASHTO Technical Committee on Roadside Safety**
Savannah, Georgia

27–30 **Automated Vehicles Symposium 2020***
San Diego, California

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.

Please contact TRB for up-to-date information on meeting cancellations or postponements. For Technical Activities meetings, please visit www.TRB.org/calendar or e-mail TRBMeetings@nas.edu. For information on all other events or deadlines, inquire with the listed contact.

RECENT AND UPCOMING WEBINARS

April

27 The Intersection Between Health and Transportation

28 Sustainable Highway Construction

30 What Role Does Ecology Have in Sustainable Transportation?

May

7 Steel Your Bridges: Preservation Practices for Steel Bridge Coatings

11 Staying Connected: Improving Your Airport's Communication Strategies

12 Attracting the Future Construction Workforce: Case Studies

13 Data-Sharing Tips for Public Transportation Agencies

18 Designing Landscapes to Enhance Roadside Water Management

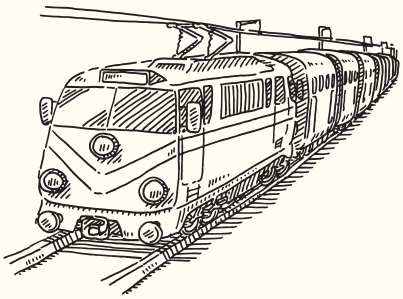
21 You Can Get There from Here: Developing an Emissions Roadmap for Airports

26 Load-Carrying Geosynthetic-Reinforced Bridge Abutments

27 Evaluating Goals Under the Disadvantaged Business Enterprise Program

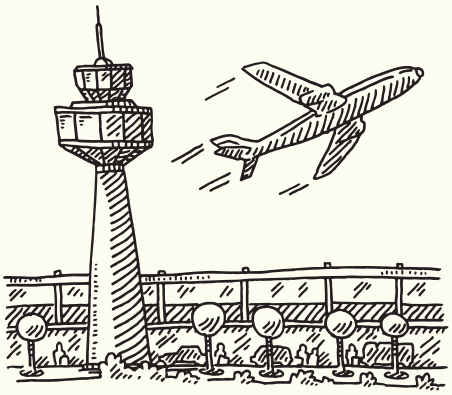
For more information, contact Elaine Ferrell, TRB, at 202-334-2399 or eferrell@nas.edu.

UPCOMING DEADLINES



Solicitations for proposals for the Transit Innovations Deserving Exploratory Analysis (IDEA) program will be released **Friday, May 1**.

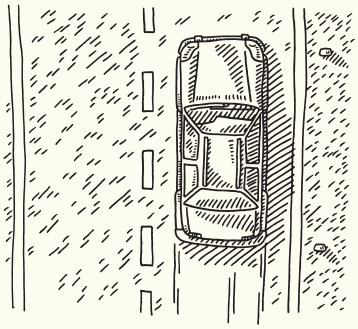
For more information, visit www.trb.org/IDEAProgram/IDEATransit.aspx.

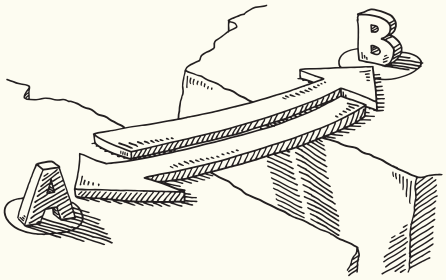


Applications for the Airport Cooperative Research Program Graduate Research Awards for Applied Research in Public-Sector Airport-Related Aviation Issues are due **Friday, May 15**. Up to ten (10) one-year awards of $12,000 each are available.

For information about application requirements, eligibility, and more, visit www.vsgc.odu.edu/acrpgraduateresearchawards or e-mail the Virginia Space Grant Consortium at ACRP@odu.edu.

The National Cooperative Research Program (NCHRP) will announce the next round of research projects, including NCHRP Synthesis projects, on **May 18** and will ask for panel nominations. Panel nominations will be accepted online through MyTRB (www.MyTRB.org). Letters of Interest from potential NCHRP Synthesis contractors also will be requested.





Transit Cooperative Research Program problem statements for FY 2021 are due **Friday, June 19**.

To submit a problem statement, visit www.surveygizmo.com/s3/5435231/TCRP-Problem-Statement-Submission-FY-2021.

INFORMATION FOR CONTRIBUTORS TO **TR NEWS**

TR News welcomes the submission of articles for possible publication in the categories listed below. All articles 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 articles accepted for publication are subject to editing for conciseness and appropriate language and style. Authors review and approve the edited version of the article before publication.

ARTICLES

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, technology, etc.). Manuscripts should be no longer than 3,000 words. Authors also should provide tables and graphics with corresponding captions (see Submission Requirements). Prospective authors are encouraged to submit a summary or outline of a proposed article for preliminary review.

MINIFEATURES are concise feature articles, typically 1,500 words in length. These can accompany feature articles as a supporting or related topic or can address a standalone topic.

SIDEBARS generally are embedded in a feature or minifeature article, going into additional detail on a topic addressed in the main article or highlighting important additional information related to that article. Sidebars are usually up to 750 words in length.

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 graphics, and are subject to review and editing.

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. Research Pays Off 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 the logo of the agency or organization submitting the article, as well a one or two photos or graphics. Research Pays Off topics must be approved by the RPO Task Force; to submit a topic for consideration, contact Stephen Maher at 202-334-2955 or smaher@nas.edu.

OTHER CONTENT

TRB HIGHLIGHTS are short (500- to 750-word) articles about TRB-specific news, initiatives, deliverables, or projects. Cooperative Research Programs project announcements and write-ups are welcomed, as are news from other divisions of the National Academies of Sciences, Engineering, and Medicine.

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, Web link, and DOI or ISBN. Publishers are invited to submit copies of new publications for announcement (see contact information below).

SUBMISSION REQUIREMENTS:

- **Articles** submitted for possible publication in *TR News* and any correspondence on editorial matters should be sent to the *TR News* Editor, Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001, 202-334-2986, or lcamarda@nas.edu.
- Submit **graphic** elements—photos, illustrations, tables, and figures—to complement the text. 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. Large photos (8 in. by 11 in. at 300 dpi) are welcomed for possible use as magazine cover images. A caption must be supplied for each graphic element.

Note: Authors are responsible for the authenticity of their articles and for obtaining written permissions from publishers or persons who own the copyright to any previously published or copyrighted material used in the articles **as well as any copyrighted images** submitted as graphics.

TRANSPORTATION RESEARCH BOARD
500 Fifth Street, NW
Washington, DC 20001

PERIODICAL MAIL
U.S. POSTAGE
PAID
WASHINGTON, DC
PERMIT NO. 244960

ADDRESS SERVICE REQUESTED

The National Academies of
SCIENCES · ENGINEERING · MEDICINE

The nation turns to the National Academies of Sciences, Engineering, and Medicine for independent, objective advice on issues that affect people's lives worldwide.
www.national-academies.org

TRN326