The National Academies of
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TRB

TRANSPORTATION RESEARCH BOARD

National Academies/TRB Forum Scoping Meeting
PREPARING FOR AUTOMATED VEHICLES AND SHARED MOBILITY SERVICES
DRAFT AGENDA
Monday, July 10, 2017   1:00 pm -5:00 pm (Pacific)
Yosemite A Room, Hilton San Francisco Union Square

I.   WELCOME

A. *Welcome & Introductions (Pedersen) (pp. 3-6)*
TRB Executive Neil Pedersen will welcome participants (see attached list), and will review the activities that have led to this scoping meeting.

B. *Agenda Overview (Dougherty)*
Malcolm Dougherty and Katie Turnbull, the Chair and Vice Chair, respectively, of the TRB Executive Committee, will review agenda for this meeting. The primary objective of this meeting will be to provide prospective Forum participants with the opportunity to refine the mission, activities, and priority focus areas of the Forum prior to its formal launch.

II.   FORUM MISSION AND ACTIVITIES (Turnbull, Norman) (pp. 7-9)

A summary of Roundtables/Forums at the National Academies, and a review of the proposed mission and activities for this Forum, will be presented. This will be followed by an open discussion on the Forum mission and activities, and on the value proposition for Forum participants.

III.   PRIORITIES FOR RESEARCH & FORUM FOCUS AREAS– VIEWS FROM THE PUBLIC AND PRIVATE SECTORS

Public sector representatives will offer their views on the issues facing public agencies in deploying automated vehicles and shared mobility services in a manner and timeframe to achieve societal objectives, and what the top research priorities and Forum focus areas should be to help address those issues. This will be followed by private sector representatives addressing the same questions.

A. *Views from the Public Sector (Facilitator: Dougherty)*

B. *Views from Private Sector (Facilitator: Turnbull)*

BREAK

IV. **PRIORITIZING THE FORUM FOCUS AREAS – BREAKOUT DISCUSSIONS (pp. 10-19)**

The proposed focus areas for the Forum listed below were selected as a result of the input received from the TRB Symposium "TRB Partners in Research: Transformational Technologies" held last fall in Detroit. Each breakout group will be asked to 1) offer additional input on the overall proposed focus areas/research priorities for the Forum, and 2) rank the top priority research issues listed under their focus area (no more than five). Listings of comments that have been submitted in response to the prior survey leading up to this meeting are attached.

A. **Safety Impacts**
Facilitator: Jim Sayer, UMTRI

B. **Transportation System Impacts**
Facilitator: Rob Bertini, USF/CUTR

C. **Social, Environmental, and Economic Impacts**
Facilitator: Susan Shaheen, UC Berkeley

D. **Data Considerations**
Facilitator: Eric Thorn, Southwest Research Institute

E. **Cross-Cutting Planning and Research Issues**
Facilitator: Kelley Coyner, George Mason

V. **FORUM SPONSORSHIP OF FUTURE TRB ACTIVITIES (Turnbull) (page 20)**

Should the Forum sponsor or co-sponsor upcoming TRB activities such as the Strategic War Game session at the 2018 TRB Annual Meeting, and or breakout sessions at the 2018 Automated Vehicle Symposium?

VI. **FORUM RESEARCH/FOCUS AREAS – REPORTS FROM BREAKOUTS (Dougherty)**

A five minute summary for each breakout will be presented.

VII. **NEXT STEP – OFFICIAL LAUNCH OF THE FORUM (Norman)**

A summary of the process and proposed timing for the official launch for the Forum, including finalizing the prospectus, obtaining approvals from the National Academies, and securing funding commitments from sponsoring organizations.

VIII. **CLOSING AND ADJOURN (Pedersen)**

IX. **Additional Informational Items**

A. **Connected and Automated Vehicles: NCHRP Support for Transportation Agency Leaders (pp. 21-25)**

B. **TRB Webpage on Transformational Technologies (page 26)**
Visit www.TRB.org/main/TransTech.aspx for access to TRB research activities, reports, conferences, meetings, webinars, and committees dealing with transformational technologies in transportation.

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PREPARING FOR AUTOMATED VEHICLES[1]
&
SHARED MOBILITY SERVICES
Prospectus for a National Academies/TRB Forum

What is a National Academies/TRB Forum?

A Forum convenes representatives of government, industry, academia, and professional organizations on an ongoing basis for the identification and discussion of issues of mutual concern. Representatives of sponsoring organizations and other government officials participate fully on Forums, as members are not subject to conflict of interest restrictions. Although a Forum may not generate formal recommendations or reports, it may commission individually-authored papers for its use and for dissemination, and it may commission workshops to inform the Forum members.

What is the Objective of the Forum on Preparing for Automated Vehicles and Shared Mobility Systems?

The objective of this Forum is to bring together public, private and research organizational partners to identify and facilitate fact-based research needed to deploy automated vehicles and shared mobility services in a manner and timeframe that informs policy to best meet long-term goals, and to share perspectives on these issues. The long-term goals include increasing safety, reducing congestion, enhancing accessibility, increasing sustainability, and encouraging economic development.

What Activities Will the Forum Undertake?

At a minimum, the activities of this Forum are expected to include the following:

- Conduct face-to-face Forum meetings at least twice a year
- Identify and share perspectives on current issues associated with incorporating automated vehicles and shared mobility services into the transportation system
- Support the development of a research roadmap that identifies the highest research priorities needed to meet the Forum Objective
- Provide input to keep the research roadmap up-to-date on an ongoing basis
- Share information on ongoing and recently completed research that can help meet the long-term policy goals noted above
- Commission authored papers to inform the Forum discussions
- Sponsor sessions at the annual TRB/AUVSI Automated Vehicle Symposium and other appropriate venues to keep Forum sponsors and others up-to-date on all of the above

If resources allow, Forum sponsors may also choose to pursue activities such as the following:

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[1] For the purposes of this Forum, "automated vehicles" will include connected/automated vehicles and autonomous vehicles.

- Raise issues that might be addressed through consensus policy and other studies conducted by the National Academies of Sciences, Engineering, and Medicine, and TRB
- Partner with relevant TRB standing committees to support their activities, including conferences, workshops, and/or webinars
- Form and pursue their own partnerships outside of the National Academies and TRB to conduct and support needed research

What Are the Potential Focus Areas for the Forum?

Forum sponsors will collectively determine the priority areas to be addressed. The 2016 TRB Symposium "Partners in Research – Transformational Technologies" identified the following potential focus areas:

- Transportation System Impacts
    - Infrastructure enablers for connected/automated vehicles and shared mobility
    - Critical paths to level 4/5 automation for light and heavy-duty vehicles (use cases)
    - Potential impacts of automated vehicles on traveler behavior and freight movement
    - Impact of shared mobility on the transportation system
    - Uses and impacts of unmanned aerial systems
- Social, Environmental, and Economic Impacts
    - Alternative scenarios for synergy among automated vehicles, shared mobility, & alternative fuels
    - Addressing social inclusion and equity in shared mobility
    - Workforce implications
    - Impacts on land use, and how land use impacts AVs and shared mobility
    - Deploying transformational technologies in dense built environments and in less dense environments (rural, suburban)
- Data Considerations
    - Data curation, sharing, and management
    - Meeting cybersecurity and privacy challenges
    - Protocols for data sharing and management for evolving freight supply chains
    - Framework for connected vehicle pilot and smart cities data analytics for policy guidance
- Cross-Cutting Topics
    - Cooperative national research planning for automated vehicles and shared mobility systems
        - Widely shared and continuously updated research roadmap
    - Precursory policy analysis for these technologies and services
        - Scenario planning, impact analysis, and economic analysis of shared automation
        - Educating the public and their elected officials on the value propositions
    - Living laboratories network and data pipeline
        - Accelerating research in automated and shared mobility, and creating data access, aggregation, sharing, and joint analytics

What Are the Dues for Sponsoring the Forum?

National Academies' Forums are supported by dues from sponsoring organizations. Annual dues levels for this Forum are shown below. Organizations that commit to a two-year Sponsorship by July 10, 2017 will be listed as Founding Sponsors of the Forum and recognized as such at the 2017 Automated Vehicle Symposium, July 11-13, 2017 in San Francisco.

Federal/State Government	$25,000
Private For-Profit	$25,000
Universities/Non-Profit	$8,000
Regional/Local Government	$5,000

4. NATIONAL ACADEMIES/TRB FORUM

PREPARING FOR AUTOMATED VEHICLES AND SHARED MOBILITY SYSTEMS

COMMENTS ON PROPOSED FOCUS AREAS

4A. SAFETY

Forum Prospectus Items
- Not included in original Forum Prospectus

Survey Comments
- We should list "Safety" somewhere.
- there could be a higher weighting on safety. 35k deaths per year and autonomous technology could potentially be pulled forward if dedicated for safety.
- Tension between the view that this innovation should be allowed to flourish for its potential to increase safety and the view that this technology needs to be approved or regulated before it can be put on public roads for testing or ultimately deployment.
- Potential impacts on safety during the "transition period," due to mixed vehicle fleets and distracted driving
- Level 3 Control Transitions: The amount of time necessary for an inattentive driver to retake control from an automated driving system in a variety of street environments, whether conditions, and traveling speeds
- Human-Machine Interface: Elements such as how vehicles understand and communicate their recognition of other street users and directions from traffic enforcement agents, and how they convey their intended actions.
- The best practices for safe testing and deployment of automated vehicles in urban centers to ensure that critical issues, such as open questions around Level 3 vehicles, are addressed in complex street environments.
- Consumer/User Education: Effective ways to communicate the specific capabilities and features of a given vehicle's automated driving system (e.g., only self-driving on highways with an adequate shoulder in sunny or partly cloudy conditions) to prevent misuse/abuse. This becomes even more complex if vehicles all have different capabilities that are regularly being changed through over-the-air updates.
- Traveler (or passenger) credentialing. In a full automated (L4/5) ecosystem there would probably never be a role for a passenger/traveler to intervene. However, L2/3, there would be. Is special training and therefore national level standard and credentialing be required?
- The impact on law enforcement, the impact on the "crash economy" (insurance, auto repair, auto parts, etc.),
- Understanding and preparing for population-level interactions with AVs,
- Anticipating consumer understanding and safe use of AV features
- Evaluating mechanisms to better standardize the consumer experience
- Validating strategies for pre-deployment safety assurances
- Performance criteria, and the impact of society knowing the exact cause of autonomous failures when they occur.
- At a fundamental level, automated vehicles must interact with human drivers and other road users in the social dance we call traffic. Human norms of behavior may not be easy to duplicate or desirable for automated vehicles. The expectations and responsibilities of automated vehicles in travel are also not clear - do we use the same legal framework to

decide what is "reasonable" behavior for an automated vehicle that we do for human drivers?

- Given that in many pedestrian fatalities, the pedestrian is at fault, we will not reach "Vision Zero" or zero fatalities unless automated vehicles not only avoid making fatal errors but compensate to some extent for humans that do. To what extent is this possible? These larger ethical considerations around vulnerable road users are important to frame.

4B. TRANSPORTATION SYSTEM IMPACTS

Forum Prospectus Items
- Infrastructure enablers for connected/automated vehicles and shared mobility
- Critical paths to level 4/5 automation for light and heavy-duty vehicles (use cases)
- Potential impacts of automated vehicles on traveler behavior and freight movement
- Impact of shared mobility on the transportation system
- Uses and impacts of unmanned aerial systems

Survey Comments
- Changing role(s) of private sector vs. public sector in planning, designing, implementing, operating, and maintaining transportation infrastructure
- May be good to clarify in "transportation system" if the Forum will focus on public transit, personal vehicles, or both.
- Equity and impacts to public transportation.
- How to incentivize shared autonomous trips/reduce the potential for an explosion in VMT.
- How to support infrastructure currently supported by fuel taxes and parking fees.
- Traveler behavior changes associated with shared mobility (e.g. time of day of travel, destination change, induced trips) to quantify the impacts on transportation system.
- Addressing fundamental travel behavior issues that, if they do not change, will severely limit or reverse potential benefits of this technology (e.g., if vehicle occupancy remains at 1.08 or lower, then automated vehicles will lead to a dramatic increase in congestion and emissions, especially if they attract people from transit)
- Infrastructure impacts especially during transition period.
- Because many transportation agencies are facing budgetary challenges, one pressing issue is whether AVs and shared mobility vehicles will place additional strain on limited funding sources.
- Management and Pricing: Opportunities and challenges of different vehicle and infrastructure pricing mechanisms to encourage efficient use of roadways, control VMT-increase, and fund infrastructure improvements.
- Trade-offs in deploying advanced technology vs. traditional maintenance of road, bridge, and other assets, as well as trade-offs with support for transit
- Relationship to existing transit systems: Effective incentives for the utilization of shared-use mobility services as supplements to existing transit networks as first/last-mile solutions, considering different integration models and the overlay of vehicle automation.
- The impacts of street design and curb regulations on automated vehicle operation and shared-use mobility services
- Consider expanding the bullet on unmanned aerial systems to include marine and submarine. These are within the scope of the Virginia task force on unmanned vehicles, for example.

- The focus on "traveler behavior and freight movement" doesn't superficially include cases where the vehicles themselves are probes (drones with cameras aren't really "freight" vehicles
- Managing the transition from a few to some to a lot to ubiquitous AVs. This transition will take place over a relatively long time. Decisions made by public agencies responsible for the planning and operations of the system can significantly impact how this transition proceeds and the degree to which it has positive transportation impacts.

4C. SOCIAL, ENVIRONMENTAL, AND ECONOMIC IMPACTS

Forum Prospectus Items
- Alternative scenarios for synergy among automated vehicles, shared mobility, & alternative fuels
- Addressing social inclusion and equity in shared mobility
- Workforce implications
- Impacts on land use, and how land use impacts AVs and shared mobility
- Deploying transformational technologies in dense built environments and in less dense environments (rural, suburban)
- Deploying transformational technologies in rural, diffuse environments

Survey Comments
- Add societal goals, such as access for all, social inclusion, planning scenarios which identify outcomes we wish to strive for.
- Disruptive impact will vary depending on the characteristics of the area. We need to understand that.
- Potential unintended impacts of automation on society, including safety, energy usage, congestion and pollution.
- Explicit and clear inclusion of potential for greenhouse gas and conventional pollution emissions, rather than a simple reference to sustainability.
- Energy use/reduction, energy security, local, regional, and national air pollutants
- Policy makers need to figure out how to include these developments in future policies including new, more stringent vehicle and engine emissions standards.
- Economic development might be a zero sum game here. Some will get it, while others while lose as the technology evolves. TRB should be neutral on this front.
- ADA issues
- This focus could more explicitly include the positives -- like productivity, quality of life improvements.
- Under "Social, Environmental, and Economic Impacts": add "transit" to the first bullet.
- The "need" for automated vehicles to make "value decisions" as they perform their functions (i.e. at times the vehicle will need to decide it is "cheaper" to take one action over another or more difficult hit a "taller human" (adult) than a "short human" (child)).
- Impacts of moving rapidly towards a system of shared, electrified automated vehicles in urban centers.
- Expand to include impacts on land use, urban form, and building design.
- Land use regulation (zoning) and urban planning to accommodate AVs and encourage adaptation of commercial real estate practice.
- Impacts on land use and how land use impacts AVs and shared mobility.
- Deploying transformational technologies in dense, built environments and less dense environments (rural, suburban).

- Emphasize and compare differences (modeling, scenario development, policy approaches) and outcomes (e.g., social, economic, and environmental) in a world where the AV is a private vehicle vs. a shared automated vehicle. It is likely there would be both options in the future, but there is an opportunity to rethink auto ownership and reliance with the advent of AV/CV technology, linked to electronic and wireless communications (logistics, fleet management).
- The economics of car ownership vs shared mobility and the role that autonomous vehicles have in shifting the paradigm of car ownership -- and resulting land use policy.
- Rethink pricing for road and infrastructure access (e.g., parking, curb space) in a way that reflects the true costs to society and in a more equitable fashion.
- Drones and courier network services will likely play an increasing role in goods delivery--contrasting to other modes of good delivery in terms of social, economic, and environmental impacts is also critical.

4D. DATA CONSIDERATIONS

Forum Prospectus Items
- Data curation, sharing, and management
- Meeting cybersecurity and privacy challenges
- Protocols for data sharing and management for evolving freight supply chains
- Framework for connected vehicle pilot and smart cities data analytics for policy guidance

Survey Comments
- Digital infrastructure
- Activities cover the data privacy issues, but the Forum might consider adding a cross-cutting topic looking at the impact on cybersecurity practices and changes that may be required.
- Understanding the need for real time communication in the mobile space to support connected/automated vehicles and shared mobility.
- Addressing consumer data privacy, transparency, access, and control.
- Ethical issues of privacy of personal data and fairness of marketing, pricing and accessibility will be good to address in order to gain the public trust.
- Data format, data management and cybersecurity
- Interface with the UN World Forum for Harmonisation of Vehicle Regulations (WP.29) including its Intelligent Transport Systems/Automated Driving Informal Group and the UN Task Force on Cyber Security and OTA issues
- Big data being generated being ignored at this time, as it is often too big to be consumable
- Cybersecurity issues associated with collecting, analyzing, and using data "at the edge" rather than transmitting and storing it all at a central source
- Storing all of the data that will be generated – especially considering laws/rules that require retention of data.
- Data scalability and management
- Regulations vs. principles/best practices in a rapidly changing environment
- Collaboration within and across various players in the public and private sectors
- The role of state and local DOTs in cybersecurity
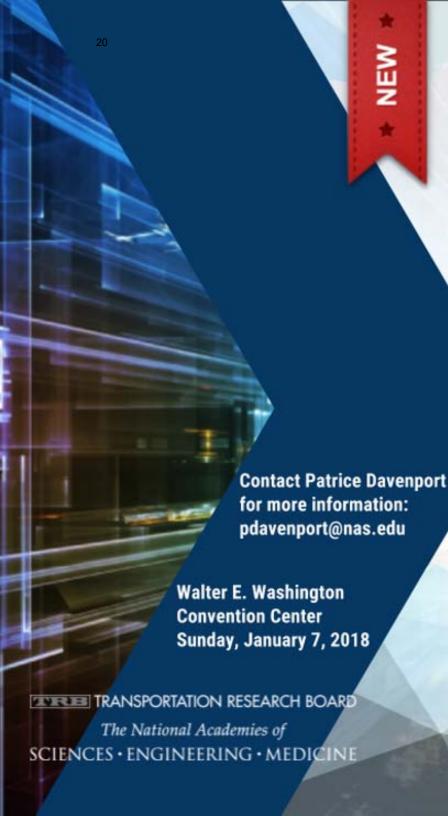- Raising cybersecurity awareness of executive managers

4E. CROSS-CUTTING TOPICS

Forum Prospectus Items

- Cooperative national research planning for automated vehicles and shared mobility systems
    - Widely shared and continuously updated research roadmap
- Precursory policy analysis for these technologies and services
    - Scenario planning, impact analysis, and economic analysis of shared automation
    - Educating the public and their elected officials on the value propositions
- Living laboratories network and data pipeline
    - Accelerating research in automated and shared mobility, and creating data access, aggregation, sharing, and joint analytics

Survey Comments

- There is a lot happening, in a lot of places, all generally moving in the same direction, but largely uncoordinated and from a wide variety of different perspectives and objectives. Making sense out of all of this and supporting some level of coordination or exchange would be a very valuable role for this Forum.
- Gain an understanding of the many private and federal funded studies that have been completed or are underway and learning about the industry's short and long plans as well as research they are conducting.
- Sharing information on ongoing and recently completed research that can help meet the long-term policy goals noted above
- May want to add a topic to consider regulatory context as regulations across states currently vary.
- Federal, State and City AV Regulation: Synchronization of legal definitions (e.g., levels of automation and the concept of "testing" versus "deployment," particularly as they apply to use in shared-use mobility services) and exploration of the implications of different regulatory steps at each level of governments, focusing on actions that can facilitate safe testing and deployment without unnecessarily hindering manufacturers.
- Regulatory environment for the deployment of L4/5 AVs. There needs to be federally stipulated operating requirements for AVs that provide consistency across city and state borders for the operation of AVs.
- What level AVs should be regulated at. Cities have especially been left out of some of the discussion, and the state/Federal split of responsibility seems to be in limbo until the new USDOT leadership decides whether to endorse or change the Obama administration guidance.
- What regulations should be put in place in advance of significant AV adoption, and what should wait until the technology evolves further. The history of the automobile and other technologies is particularly appropriate to bring to bear, and TRB might do well to include some transportation historians.
- Add emphasis to nimble and fast-moving research.

- Possible migration paths/phasing/scenarios to full adoption - where, what, and under what conditions, prerequisites of success for subsequent phases.
- It might be useful to understand and study the latest advancements in Europe and Asia to learn best practices and recent advancements in the areas of shared mobility and automated vehicles.
- Multimodal, transit, and mobility as a service
- What are the measurable metrics for the long-term goals include increasing safety, reducing congestion, enhancing accessibility, increasing sustainability, and encouraging economic development?   For example, how do you measure accessibility or economic development? How do you discuss the interdependencies of these?
- How do you articulate return on investment to those stakeholders in state, local, federal government or otherwise that have to form the polices and make the investments into infrastructure the measurable benefits across the aforementioned long term goals?
- Business models and potentially different impacts on transit in urban vs rural settings.
- Educating the public and their elected officials on the value propositions.
- Institutional and policy issues, broadly construed, to include formal institutions (organizations, departments, agencies, industry structure, statutes and regulations) and informal institutions (attitudes about privacy, role of government).
- Financial issues. Who pays? Who is responsible and accountable for what?
- There remains a tremendous amount of work that needs to be done to understand and prepare for population-level interactions with AVs, and to directly inform public policy on autonomous vehicles.
- Understanding the impact of various regulatory regimes on testing and deployment
- Preparing state and local driving laws for AV deployment.
- Discuss the realities that the last 1% or 2% of finishing out AVs is much more complex than is often widely discussed (i.e. we are not going to see fleets of AVs on our freeways in mixed/mode traffic in 2020).
- Need for changes to procurement rules and practices employed by public agencies

NEW

JOIN TRB'S FIRST STRATEGIC
WAR GAME!

How can technology, public policy, and market forces be aligned to achieve greatest societal benefits?

THE SCENARIO:

New technologies will likely create winners, losers and unanticipated ripple effects. Building upon NCHRP Foresight 750 Series, teams will "compete" in a facilitated open-ended competition to "solve" this challenge with a transformation solution.

WHAT IS A STRATEGIC WAR GAME?

A scenario-based, focused experiential activity that places participants in a simulated situation that requires them to go through a decision-making process close to real life in a safe future environment. War games are effective because they:

- Bring a wide variety of ideas together as competitor and market teams, take on the roles of the players in the industry
- Are simulations rooted in reality. Briefing materials provide the facts of the industry so competitive teams are forced to deal with real-world constraints

Contact Patrice Davenport for more information:
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Walter E. Washington Convention Center
Sunday, January 7, 2018

TRB TRANSPORTATION RESEARCH BOARD
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May 2017

Connected and Automated Vehicles

NCHRP SUPPORT FOR TRANSPORTATION AGENCY LEADERS

The National Academies of
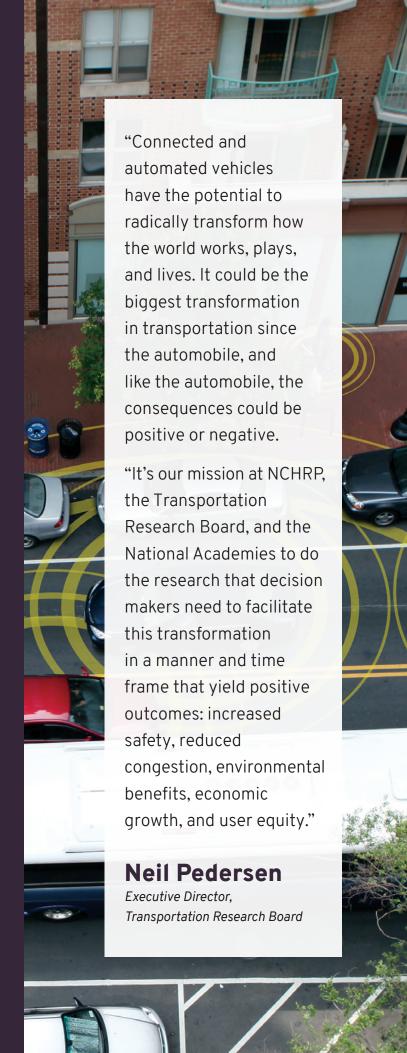SCIENCES · ENGINEERING · MEDICINE

TRB
TRANSPORTATION RESEARCH BOARD

NCHRP: YOUR RESEARCH PROGRAM

AASHTO members commit State Planning and Research Program funding to support and oversee NCHRP, which pools the states' research dollars to find solutions to transportation challenges identified as critical by the states.

Established as a part of the Transportation Research Board (TRB) in 1962, NCHRP is part of the independent and interdisciplinary National Academies of Sciences, Engineering, and Medicine (NASEM). NCHRP's connection to TRB and NASEM provides trusted objectivity across the full range of transportation areas.

Learn more at trb.org/nchrp.

"Connected and automated vehicles have the potential to radically transform how the world works, plays, and lives. It could be the biggest transformation in transportation since the automobile, and like the automobile, the consequences could be positive or negative.

"It's our mission at NCHRP, the Transportation Research Board, and the National Academies to do the research that decision makers need to facilitate this transformation in a manner and time frame that yield positive outcomes: increased safety, reduced congestion, environmental benefits, economic growth, and user equity."

Neil Pedersen
*Executive Director,
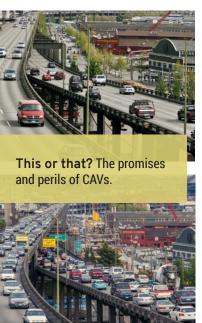Transportation Research Board*

SELF-DRIVING CARS: THE FUTURE IS NOW

Or if not now, likely tomorrow or the day after.

Connected and automated vehicles (CAVs) are poised to change the landscape of transportation, but the possible future paths for CAVs diverge dramatically.

A best-case scenario for CAVs could be a major reduction in personal vehicle ownership, with shared-ride CAVs effectively serving as an alternative public transportation system without fixed routes. The flipside scenario for CAVs could be longer acceptable commutes for CAV owners, with increased traffic congestion, and even the prospect of empty cars that roam city streets when parking spots are scarce.

This or that? The promises and perils of CAVs.

Images courtesy of C. J. Oliver (CC BY-NC 2.0) and Tony Webster (CC BY 2.0)

The National Renewable Energy Laboratory estimates that potential emissions impacts of CAVs could swing from a 60 percent drop to a 200 percent increase. It is little wonder, then, that interest is high in undertaking national research to inform short- and long-term decisions about CAVs.

NCHRP is in its sixth decade of administering high-priority research for state DOTs on the full range of transportation challenges that they face. Just as state DOTs have led in long-established research areas like bridges, pavements, safety, and operations, they are once again on the vanguard of research through NCHRP.

NCHRP is addressing the myriad issues DOTs are facing with respect to CAVs, including technology, infrastructure, human–machine interaction, licensing, liability, and legalities. Through a coordinated research effort, NCHRP is developing products that will support DOT executives in realizing the best possible future with CAVs.

KEEPING PACE WITH LEGAL ISSUES

"How soon and how smoothly driverless vehicles merge onto U.S. roads and highways will depend, in part, on how the legal system resolves the many legal issues implicated by these vehicles," according to *NCHRP Legal Digest 69: A Look at the Legal Environment for Driverless Vehicles.* The report, available on TRB's website, provides extensive citations for DOT policymakers and state lawmakers about the evolving legal landscape for CAVs. Topics include:

- Civil liability for personal injury
- Criminal law and procedure
- Automobile insurance structures
- Privacy and security laws
- Legislative and regulatory issues
- Land use, environmental, and infrastructure issues

"May I see your license and registration?" Police pull over a self-driving car in an evolving legal landscape.

Image courtesy of Zandr Milewski

The report notes that CAVs appear to be transforming much more rapidly than the traditionally cautious and slow-to-change legal system: "The legal response to driverless vehicles has already begun with basic measures, such as laws that simply authorize the use of these vehicles in some states. … As driverless vehicles grow more sophisticated and common, they will assuredly generate many [new legal issues]."

While laws affecting CAVs will likely be shaped by analogies to conventional vehicles, over time, "policymakers will come to better appreciate, and begin to focus on, the unique capacities of, and challenges presented by, driverless vehicles and the system that supports them," according to the report.

A COORDINATED RESPONSE TO PRESSING QUESTIONS

NCHRP is administering research on a wide range of technical, operational, and policy challenges related to CAVs primarily through NCHRP Project 20-102, Impacts of Connected Vehicles and Automated Vehicles on State and Local Transportation Agencies.

Some research topics are completed and others are ongoing, following a CAV research roadmap directed by top-level practitioners, leaders, and experts. Beyond the work highlighted below, more is on the way. For example, states wrestling with infrastructure funding questions will find value in an upcoming synthesis of practice to forecast vehicle miles traveled by CAVs.

NCHRP 20-102(01) Policy and Planning Actions to Internalize **Societal Impacts** of CV and AV Systems into **Market Decisions**

NCHRP 20-102(02) Impacts of Regulations and Policies on CV and AV Technology Introduction in **Transit Operations**

NCHRP 20-102(03) Challenges to CV and AV Application in **Truck Freight** Operations

NCHRP 20-102(05) **Strategic Communications** Plan for NCHRP Project 20-102

NCHRP 20-102(06) Road Markings for **Machine Vision**

NCHRP 20-102(07) Implications of Automation for **Motor Vehicle Codes**

Implicit in traditional motor vehicle codes are assumptions about drivers maintaining attention to and control over their vehicles. With this project, NCHRP is coordinating with the American Association of Motor Vehicle Administrators to develop CAV guidance and resources for DOTs and DMVs.

Image courtesy of Steve Jurvetson (CC BY 2.0)

NCHRP 20-102(08) **Dedicating Lanes** for Priority or Exclusive Use by CVs and AVs

This project addresses a near-term issue as CAVs mix with traditional vehicles: What is the formula for getting maximum benefit, and how is that achieved? More lanes? Repurposing of existing lanes? The research will also examine the negative impacts on non-CAV users and projected market changes over time.

Image courtesy of U.S. DOT Intelligent Transportation Systems Joint Program Office

NCHRP 20-102(09) Providing Support to the Introduction of CV/AV Impacts into **Regional Transportation Planning and Modeling** Tools

NCHRP 20-102(10) **Cybersecurity** Implications of CV/AV Technologies on State and Local Transportation Agencies

Opinions vary about the risks associated with the possible hacking of today's intelligent vehicles (and tomorrow's CAVs). Even so, cybersecurity remains an issue of keen interest and concern. This research will provide a primer on CAV cybersecurity based on experience from other areas (such as financial services) where security and privacy issues are well managed today.

NCHRP 20-102(11) Summary of Existing Studies on the Effects of CV/AV on **Travel Demand**

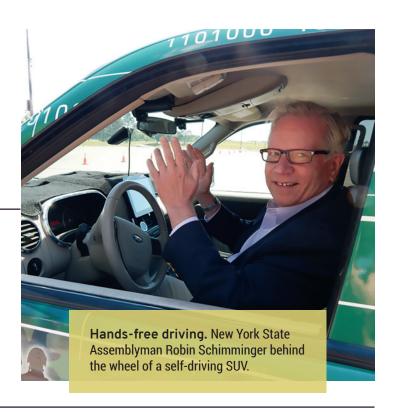**NCHRP 20-102(12)** Business Models to Facilitate **Deployment of CV Infrastructure** to Support AV Operations

NCHRP 20-102(13) **Planning Data Needs** and Collection Techniques for CV/AV Applications

NCHRP 20-102(14) **Data Management** Strategies for CV/AV Applications for Operations

CONVENING TOP-LEVEL LEADERS

CAVs are both a national topic and a day-to-day issue for state DOTs. Information sharing and strategic partnering across state lines and across the nation are paramount. TRB continues to create opportunities for DOT executives and decision makers to dialogue on the most pressing—and constantly shifting—issues related to CAVs.

NCHRP's triennial **State DOT CEO Leadership Forum** will zero in on CAV and transportation infrastructure readiness in 2017. To be held in conjunction with the October 2017 ITS World Congress in Montreal, the forum will be an opportunity for DOT directors to share concerns, lessons learned, and successful strategies related to CAV infrastructure.

Hands-free driving. New York State Assemblyman Robin Schimminger behind the wheel of a self-driving SUV.

The July 2017 **Automated Vehicles Symposium**, cosponsored by TRB and the Association for Unmanned Vehicle Systems International, marks the seventh year of this growing event. Interest is tremendous— the symposium has become TRB's second largest event after its annual meeting. The symposium in San Francisco will bring together industry, academia, and government to expedite the future of CAVs.

With CAVs such a fast-moving area, NCHRP's research roadmap needs to be flexible too. TRB is organizing a national public–private–university **Forum on Preparing for Automated Vehicles and Shared Mobility Systems.** An outgrowth of NCHRP Project 20-113, Research Roadmap—Transformational Technologies, the forum will meet twice a year to continuously update NCHRP's research roadmap.

CONTACT US

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For more information about TRB's activities in transformational technologies (including CAVs), please visit TRB's transformational technologies web page at trb.org/main/TransTech.aspx or contact:

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