The U.S. Department of Transportation's Smart City Challenge

and the

Federal Transit Administration's Mobility on Demand Sandbox

Advancing Multimodal Mobility and Best Practices Workshop

January 8, 2017
Washington, D.C.

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The **Transportation Research Board** is one of seven programs of the National Academies of Sciences, Engineering, and Medicine. The mission of the Transportation Research Board is to provide leadership in transportation innovation and progress through research and information exchange, conducted within a setting that is objective, interdisciplinary, and multimodal.

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Jennifer Correro, Proofreading and Layout

Contents

Executive Summary

The market for personal mobility is changing rapidly due to shifting social and cultural trends, as well as technological advances such as smartphones, information processing, and widespread data connectivity. Mobility on demand (MOD) is an innovative transportation concept where mobility consumers reserve, dispatch, or use shared mobility and public transportation solutions in place of privately owned modes. The most advanced forms of MOD incorporate trip planning and booking, real-time information, and fare payment into a single-user interface. Modes facilitated through MOD providers can include carsharing, bikesharing, ridesharing, ridesourcing, scooter sharing, microtransit, shuttle services, public transportation, and other emerging transportation solutions. Common goals among MOD providers can include the following:

1. Offering short-term access to mobility solutions for users;
2. Enhancing convenience by facilitating trip planning, payment, and other functions into a single interface;
3. Providing cost savings since customers generally pay per use, often resulting in cost savings over private vehicle ownership, maintenance, repair, and insurance;
4. Improving transportation network efficiency through enhanced traveler information, demand management, and pricing management mechanisms; and
5. Increasing mobility options (e.g., journeys previously inaccessible by a single mode, first-and-last mile connections, and additional service offerings during off-peak or high-congestion travel times).

Other popular terms include shared mobility, mobility as a service, and transportation as a service.

On January 8, 2017, the U.S. Department of Transportation (DOT) and the Transportation Research Board (TRB) of the National Academies cohosted a workshop on the U.S. DOT's Smart City Challenge and the Federal Transit Administration's (FTA) MOD Sandbox: Advancing Multimodal Mobility and Best Practices at the 96th Annual Meeting of the Transportation Research Board in Washington, D.C. The workshop was sponsored by the following stakeholders:

- Emerging and Innovative Public Transport and Technologies Committee (AP020);
- Shared-Use Mobility and Public Transit Subcommittee [AP020(1)];
- Emerging Ridesharing Solutions Joint Subcommittee [AP020(2)];
- Automated Transit Systems Committee (AP040); and
- Transportation Demand Management Committee (ABE50).

Organization of this workshop was made possible by the sponsors and the organizing committee members: Susan Shaheen, Jeffrey Chernick, Prachi Vakharia, Mark Dowd, and Bob Sheehan.

The workshop facilitated a dialogue among over 165 participants from public-sector organizations, private companies, nonprofit research groups, and educational institutions. The workshop featured thought leaders and finalists from the 2016 U.S. DOT's Smart City Challenge

and FTA's MOD Sandbox. The workshop emphasized the role of public transit, shared mobility, and advanced technology (connected and automated vehicle technology, sensing, cameras, etc.) in the recent competitions, along with next steps and plans for researching the pilot projects and documenting best practices. Sessions featured the U.S. DOT Smart City Challenge winner: Columbus, Ohio, and highlighted pilot projects from the FTA MOD Sandbox, along with selected public–private partnerships and research initiatives on the future of mobility. Government, industry, and academic thought leaders presented and participated in panel discussions with the audience about the pilot projects, public–private partnerships, research, and next steps, emphasizing the future of multimodal mobility. In the second half of the workshop, attendees participated in interactive breakout sessions and reported back on next steps for advancing research and policy understanding in public transport innovation, as well as use cases in the context of a range of use cases (urban, suburban, and rural).

The workshop addressed several key goals:

- Discussing the interrelated nature of smart cities and MOD;
- Enhancing public transit industry preparedness for MOD and smart cities;
- Initiating a dialogue between public organizations and private companies;
- Evaluating the reach of MOD beyond dense urban centers; and
- Discussing current research and policy in light of rapidly evolving technology and service disruption.

Dignitaries and industry experts spoke at length about lessons learned from U.S. DOT's Smart City Challenge, FTA's upcoming MOD Sandbox initiative, and the critical role of public–private partnerships.

The workshop focused on many of the new trends in MOD. The role of MOD and mobile technologies (e.g., smartphones and apps) was discussed in a variety of contexts and how these innovations are changing the way people travel and make trips on a daily basis. The need for equity and not leaving anyone behind was highlighted throughout the panel and breakout sessions. It is important to be as inclusive as possible, especially to individuals lacking digital access, those living in lower-density communities, households of all socioeconomic backgrounds, and people with disabilities. Key insights and discussion points from the workshop include the following:

1. **Key performance measures for smart cities and MOD** are safety, affordability, reliability, and availability to all. Measuring these metrics requires a greater understanding and response to individual and societal goals, such as protecting traveler safety; understanding traveler needs and preferences; ensuring comfortable and convenient travel; advancing education, health, and safety; ensuring environmental sustainability; and more broadly, getting people to where they want to go.

2. **U.S. demographics are changing rapidly and so are technological trends**. There is an increasing number of older adults aging in place and, given the rise of automated vehicles and innovation in mobility services, there are opportunities for on-demand modes to enhance access for older adults, children, and people with disabilities.

3. **It is important to not only learn from Smart City and MOD successes but from failures as well**. For instance, MOD may not have been as successful everywhere as it is in

dense urban areas. There should be a focus on opportunities for enterprise commute solutions or transportation demand management stemming from employers.

4. **There is a big gap in rural MOD, and MOD solutions should be incorporated into rural communities**. There are not many successful MOD solutions in rural areas. Sponsoring a "Smart Rural Challenge" to encourage digital and transportation infrastructure improvements in rural communities could be a start to address this gap.

5. **Courier network services (CNS), also referred to as flexible goods delivery, are on the rise and the business models could evolve to be used interchangeably for goods and people mobility.** Two general emerging models of CNS are point-to-point (P2P) delivery services and paired on-demand passenger ride and courier services. In addition to CNS, attention to the use of drones for goods delivery is important as it could disrupt the transportation ecosystem and provide many societal benefits. These areas need further research, as they are not well understood, at present.

6. **Multijurisdictions represent another key challenge area.** For example, how can ridesourcing or transportation network companies (TNC) trips be subsidized with origins and destinations in different counties (or even crossing state lines)?

7. **Improving data sharing, data accessibility, and data integration are key to the success of MOD and Smart Cities.** Moreover, there is a need for a platform that can integrate data seamlessly and provide the user with an easy access and simple payment method for all the transportation methods used in one origin–destination trip.

8. Finally, **it is important to align funding with priorities, recognize diverse traveler needs, improve understanding of the adoption of innovative technologies, and overcome barriers that exist with special populations** that can potentially limit the availability or use of MOD and Smart City solutions.

This workshop synopsis covers findings and discussions from the event and summarizes the key topics explored throughout the day. The workshop commenced with introductions from the day's facilitators: Susan Shaheen from the University of California, Berkeley (UC Berkeley) and Jeffrey Chernick of RideAmigos and the respective chairs of the Shared-Use Mobility and Public Transit Subcommittee and the Emerging Ridesharing Solutions Joint Subcommittee. Following participant introductions, the three expert panel sessions, along with key points made by each panel, are summarized. Next, the interactive breakout sessions, along with a synopsis provided by the lead moderators, are discussed. The breakouts were organized by land use context: urban, suburban, and rural. Finally, closing thoughts and key takeaways from the workshop are presented. The workshop agenda is provided, along with key takeaways.

Panel Sessions

SESSION 1: WORKSHOP OVERVIEW AND PARTICIPANT INTRODUCTIONS

The workshop started with an overview by Susan Shaheen and Jeffrey Chernick. Shaheen set the stage for the day by presenting an overview of the agenda and kicked off participant introductions.

SESSION 2: U.S. DOT's SMART CITY CHALLENGE AND COLUMBUS, OHIO'S, MULTIMODAL VISION

The first panel session of the morning, moderated by Mark Dowd of the Office of Management and Budget of the White House, consisted of five expert panelists: Spencer Reeder, Vulcan; Alex Fischer, Columbus Partnership; Aparna Dial, City of Columbus; and Guruprasad (Guru) Vasudeva, Nationwide Property and Casualty.

Dowd opened the session with a discussion about the Smart City Challenge—broad comments about the majority of applicant cities while highlighting noteworthy aspects from Smart City Challenge winner Columbus, Ohio. He noted some of the reasons Columbus was selected. Dowd emphasized that the challenges identified by Columbus were consistent across other applicants. What distinguished Columbus, however, was their unique perspective and different approaches to creating partnerships. Dowd discussed the powerful narrative from Columbus' application: an industrial city in mid-America transforming from industrial to post-industrial notions of mobility and urban development. U.S. DOT viewed Columbus' application as a model for what communities across the country need to do to succeed. Spencer Reeder of Vulcan highlighted their involvement in the Smart Cities Challenge process and discussed their memorandum of understanding with the U.S. DOT. Reeder highlighted an enormous effort by Vulcan and U.S. DOT to work together and integrate efforts. Reeder emphasized the importance of incorporating data-driven performance measures to ensure success and program accountability.

Aparna Dial from the City of Columbus talked a lot about navigating a complex stakeholder environment to develop a winning application. Dial emphasized the importance of getting all the stakeholders together and developing concepts to leverage Smart City technologies to solve community problems. Alex Fischer of the Columbus Partnership highlighted the numerous public–private partnerships, including sponsorships from American Electric Power and Ohio State University to name a few. Guruprasad (Guru) Vasudeva of Nationwide Property and Casualty highlighted their company's partnerships with the public sector and academia. Vasudeva highlighted three critical interests from the insurance sector:

1. The impact of on-demand mobility on insurance;
2. Their firm's large investment in the real estate sector (and how on-demand mobility may impact those real estate holdings); and
3. How insurance companies can help their local community.

Vasudeva discussed the convergence of shared, electric, connected, and automated (SECA) vehicles and the potential need for industry to re-examine traditional norms. Highlighting his firm's investments in Columbus' hospital industry, Vasudeva said, "If SECA takes hold, do we need parking lots? How do we transform from building a parking lot to the next phase of development?"

Dowd and Reeder concluded the panel with some panel questions and discussion on the fast-paced nature of the Smart Cities Challenge. Dowd pointed out that people worked together as a team, in part, because of the very fast nature of the challenge. Reeder emphasized the importance of leveraging memoranda of understanding (or MOUs) to integrate and streamline processes, such as the Smart Cities Challenge. At the conclusion of the panel, a few people in the audience asked questions. One member of the audience asked for more details about the projects being implemented in Columbus. Dial responded by naming specific Smart City initiatives including bus rapid transit, LED street lights, WiFi in street lights, and leveraging Smart Cities technologies to respond to key community problems, such as infant mortality and access to neonatal appointments. In response to a follow-up question regarding performance monitoring and project tracking, the panel emphasized the importance of making sure the hypotheses used measure the outcomes that are trying to be achieved in Columbus. Dial noted that they have a project management process to monitor project performance including an independent auditor and an U.S. DOT evaluation. Columbus plans to release key performance metrics publicly in the first quarter of 2017.

SESSION 3: FTA's MOBILITY ON DEMAND SANDBOX

In the second session, experts in this panel spoke about MOD key performance indicators. Many issues were covered, such as the intermodal and cross-office collaboration within and outside of the U.S. DOT and the broader vision for the MOD research program.

Moderator Vince Valdes of the FTA opened by speaking about the goals of the MOD Sandbox program. Gwo-Wei Torng, Director of the Office of Mobility Innovation at FTA discussed traveler centric choices, the ways in which public transit service is measured, and performance metrics to monitor success. Torng emphasized that current policy regulations are being evaluated to better identify and understand if existing regulations support the advance of MOD innovations. Torng also stated that FTA has a brochure that explains what funds can be used on various mobility investments intended to clarify and improve understanding. Torng also highlighted FTA's new online Shared Mobility Dialogue that allows the public to present their own ideas, as well as vote and comment on existing ideas.

Chris Pangilinan of the Transit Center spoke about how to develop performance indicators. He emphasized the need for agencies to develop new approaches to integrate agency goals, objectives, and metrics with MOD services. Emphasizing "safety, affordability, reliability, and availability to all," Pangilinan said that measuring these metrics requires a greater understanding and response to individual and societal goals, such as protecting traveler safety; understanding traveler needs and preferences; ensuring comfortable and convenient travel; advancing education, health, and safety; ensuring environmental sustainability; and more broadly, getting people to where they want to go.

Yi-Chang Chiu of Metropia spoke about founding Metropia and its role in changing user behaviors. Chang also discussed changing demographic and technological trends, including an

increasing number of older adults aging in place and the opportunities for on-demand modes (in the future of automated vehicles) to enhance access for older adults and children.

Steve Raney of Joint Venture Silicon Valley started with a provocative statement: "MOD is failing except in a few urban areas." Raney emphasized the need to learn not just from MOD successes but from MOD failures. He discussed the opportunities of enterprise commute solutions (or transportation demand management stemming from employers), mobility aggregation, and feebates (a system of charges and rebates where environmentally sustainable practices are rewarded while failure to adhere to such practices are penalized) to address systemic obstacles. Raney concluded by emphasizing the need to develop "multi-way wins" among an array of stakeholders including cities, counties, regional agencies, mobility services, employers, and public transit.

Valdes posed a key question to the panelists: "Given your assessment, what do we have to do to move the needle?" In other words, "What do you want to see in MOD 2.0?" Collectively, the panelists identified the significance of learning from MOD 1.0, the need to incorporate MOD into rural communities, and the importance of improving data sharing and data accessibility. The panelists also identified the need to align funding with priorities, recognize diverse traveler needs, improve understanding of the adoption of innovative technologies, and overcome barriers that exist with special populations that can potentially limit the availability or use of MOD.

PART 1 OVERVIEW

Shaheen and Chernick wrapped up with an overview of Part 1, noting the emphasis of the morning discussions on two notable U.S. DOT initiatives in 2016—the Smart City Challenge and FTA's MOD Sandbox. Prior to adjourning the workshop for lunch, Shaheen also announced a newly released book published by Springer, *Disrupting Mobility: Impacts of the Sharing Economy and Innovative Transportation on Cities*, which was cosponsored by many of the same committees hosting the TRB workshop.

SESSION 4: PUBLIC–PRIVATE PARTNERSHIPS TO ADVANCE MOBILITY ON DEMAND

In the third panel, experts highlighted the role of public and private partnerships in research. Moderator Bob Sheehan of FHWA's Intelligent Transportation Systems Joint Program Office opened the session by establishing a baseline understanding of mobility on demand. Sheehan said "All travelers deserve mobility choices, aging Americans require mobility choices, and millennials want mobility choices." He talked about the following potential benefits of MOD:

1. Increased traveler information,
2. A customer-focused transportation network,
3. Multimodal connectivity,
4. Extending the catchment area of public transportation,
5. The ability to connect passengers with service providers, and
6. The need for mobility managers to develop new partnerships and disseminate streamlined and integrated transportation information to prospective users.

Sheehan concluded by highlighting six key challenges:

1. Bridging first-and-last mile connections;
2. Improving access to and knowledge of mobility options;
3. Maximizing infrastructure and network capacity;
4. Enhancing infrastructure, fare, and information technology integration;
5. Bridging real-time information gaps and improving information services; and
6. Enriching the customer experience.

Following his remarks were presentations by teams representing three kinds of partnerships: governmental, public–private, and research.

Michael Berube of the U.S. Department of Energy (DOE) and Marcia Pincus of FHWA discussed U.S. DOT and U.S. DOE's 2016 MOU, which enables the agencies to pursue opportunities for collaborative action to accelerate innovative transportation research, development, demonstration, and deployment. Berube discussed U.S. DOE's role in transportation pointing out that 70% of petroleum consumption is used by the transportation sector and how changes in mobility can represent a catalyst for change, both in terms of environmental sustainability and energy independence. Pincus pointed out that the U.S. DOT–DOE partnership means that larger projects can be funded. Pincus also discussed the SMART Mobility Lab effort that examines electrification, decision sciences, multimodal impacts, and infrastructure.

Jameson Auten of Kansas City discussed the Kansas City Area Transportation Authority (KCATA) partnership with Bridj that commenced operations in March 2016. The pilot program allows KCATA to offer flexible transit services using 10 14-passenger vans. Bridj is a microtransit provider specializing in semiflexible demand-responsive routing. Auten focused on KCATA's innovation process, which required the agency to get a procurement exception for the Bridj pilot in Kansas City. This process also emphasizes the need to work closely with FTA on a regular basis. Auten identified some challenges to the pilot project, such as marketing and serving unbanked users. He also highlighted the importance of targeted marketing and stated that a solution for unbanked users will be unveiled with RideKC 2.0.

Next, Amanda Eaken of the Natural Resources Defense Council (NRDC) and Shaheen talked about their research partnership to study the impacts of Lyft and Uber. The study will assess before-and-after impacts of passengers and drivers on travel behavior, vehicle ownership and use, and vehicle miles or kilometers traveled. As of October 2016, the ongoing study had received data from 10,000 completed user surveys in Los Angeles, San Francisco, and Washington, D.C. The study team also collected driver data from an estimated 5,000 ridesourcing drivers. Shaheen also pointed out that the study includes a control survey of the general population to track whether changes in public transit ridership, car ownership and use, and other factors are due to ridesourcing or external forces. Shaheen and Eaken also said that they are seeking data from the operators to assess activity from the operator perspective. They emphasized the groundbreaking nature of the study and how, when complete, it will dispel anecdotal beliefs about how ridesourcing has been used.

Breakout Sessions

After Session 4, the workshop attendees organized into one of three breakout sessions and discussed use cases for MOD based on three land use environments: urban, suburban, and rural. Breakouts were conducted at each table by facilitators and notetakers and summarized by three breakout moderators (one for each land use environment). Facilitators at each table followed a standard protocol intended to probe key questions applicable to MOD across each of these land use environments. The protocol asked participants to spend 90 min (approximately 30 min per topic area) discussing the following questions:

1. **Use cases.** What are the key use cases (e.g., first and last mile, elderly, disabled, goods delivery) for each land use environment?
2. **Benefits and knowledge or evidence needed.**
   a. What kinds of social, economic, and environmental benefits might MOD achieve in your specific land use environment?
   b. What issues, questions, barriers, or enablers are being discussed in your organization or region (please address within your respective land use environment-- rural, suburban, or urban)?
   c. What knowledge or evidence does your organization need to participate in, promote, or implement MOD?
3. **What policy, actions, and support are needed?**
   a. What is needed to communicate with and engage the user–traveler in MOD?
   b. What actions are needed to support these goals (e.g., policy change, removing barriers) in your specific land use environment?
   c. What do you think is needed to facilitate collaboration among various MOD stakeholders?

After a lively exchange of ideas in the breakout sessions, lead moderators of each breakout reported back the key ideas that came out of their respective discussions. Special thanks go to the following individuals for their role as facilitators and notetakers during the breakout session: Allen Greenberg, FHWA; Prachi Vakharia, RideAmigos; Jana Sochor, Chalmers University; Stephen Zoepf, Stanford; Gary Hsueh, Arup; Justin Holmes, Zipcar; Amanda Eaken, NRDC; Emily Castor, Lyft; Katherine Kortum, Transportation Research Board; Sharon Feigon, Shared-Use Mobility Center; Shannon McDonald, Southern Illinois University Carbondale; Sabrina Sussman, NYC, Office of the Mayor; Balaji Yelchuru, Booz-Allen Hamilton; and Katherine Freund, ITN America.

URBAN

Urban MOD use cases was summarized by Amanda Eaken of NRDC. Common use cases identified included first- and last-mile connections to public transportation, urban goods movement (e.g., CNSs), daily commuting and other business trips, school trips, and trips for people with special needs, such as disabled users, caregivers, medical trips, etc. Use cases for special circumstances, including special events and disaster response (e.g., evacuation), were

also identified. Participants emphasized the importance of leveraging MOD to allow urban users to make spontaneous transportation decisions. Potential benefits enabled through urban MOD include reducing the number of single-occupant vehicles, congestion, and emissions; increasing affordability of transportation and housing (the latter through less parking infrastructure); improving access to jobs and health care; and improving access for people with disabilities. Common challenges identified include the following:

1. Perceived negative effects on retail (by reducing parking or vehicle access);
2. Pressure from political stakeholders and lobby groups (e.g., taxi industry, trucking industry); and
3. Perceived and real lack of leverage by local governments to enforce standards and performance targets on private-sector operations.

Partnering with the private sector and creating open platforms (e.g., data sharing and data commons) were identified as potential opportunities to support urban MOD. Breakout participants emphasized the need to distinguish between vendors and partners. Participants indicated that setting environmental goals and making the private sector pledge to achieve environmental goals may be one way to distinguish mobility partners from mobility vendors. Participants also emphasized the need to improve procurement processes to make it easier for public agencies to conduct business with the private sector (and vice versa). Participants indicated that U.S. DOT can support urban MOD by

1. Setting standards for the private sector;
2. Developing incentives for pilot demonstrations and other innovations;
3. Partnering with the private sector through risk-sharing partnerships;
4. Clarifying what public funding is available to shared mobility operators; and
5. Improving travel behavior data through technology and travel diaries.

SUBURBAN

The second breakout session, suburban MOD use cases, was summarized by Emily Castor of Lyft. Common suburban use cases identified were similar to urban use cases and included first- and last-mile connections to public transportation, daily commuting and other business trips, school trips, trips for low-income and carless households, and trips for people with special needs, such as disabled users, caregivers, medical trips, etc. Some participants noted difficulty in identifying "suburban" use cases as a category due to the range of suburbs, such as medium density (e.g., Tyson's Corner, Virginia), suburban (e.g., Orinda, California), and exurban (very low density). Participants emphasized the importance of leveraging MOD to allow urban users to make spontaneous transportation decisions and discussed the potential for MOD to facilitate suburban goods movement (e.g., CNSs and drones). Potential benefits enabled through suburban MOD identified include the following:

1. Enhanced accessibility,
2. Improved convenience,
3. Reduced travel times,

4. Less parking demand,
5. Increased densification by eliminating obsolete land uses (e.g., park-and-ride lots), and
6. Increased social and economic inclusion.

The greatest challenge identified include is competition with personal (and more specifically single occupant) vehicles. Participants also recognized that incentives may also be a barrier because ridesourcing/TNCs can be less affordable in the suburbs due to a variety of factors, such as fewer drivers and longer trip lengths. Similarly, improving real-time data services and partnering with the private sector and creating open platforms (e.g., data sharing and data commons) were identified as key opportunity areas for the advancement of suburban MOD. Participants indicated the U.S. DOT can support suburban MOD by improving data collection, analysis, and overall understanding of MOD travel behavior, providing flexible funding sources to encourage public and private partnerships, more flexible parking and zoning codes, and encouraging technological integration and interoperability between the public and private sector through incentives.

RURAL

The rural MOD use cases, was summarized by Jana Sochor of the Chalmers University of Technology (Gothenberg, Sweden). Common rural use cases identified include access to

1. Resource-based jobs (e.g., farms, mining, etc.);
2. Special needs populations (e.g., older adults, low-income and carless households, and people with disabilities); and
3. Nearby airports and medical care.

Participants noted that resources for rural transit vary considerably by state. Participants raised the question: "How do we share vehicles in rural areas?" Participants noted that potential use cases should include classic forms of MOD not requiring technological access, such as casual carpooling, to overcome digital poverty and poor cellular data access in rural areas. Participants also noted opportunities to partner with faith-based organizations and other types of associations and gathering places common in rural communities. Finally, participants identified potential commercial use cases to receive goods (e.g., grocery delivery and deliveries from both brick-and-mortar and online retailers), as well as a way to bring goods to market (e.g., produce and poultry from rural areas to more urbanized areas for sale). Participants emphasized the importance of leveraging rural MOD to overcome physical and social isolation. Participants noted in some cases that digital accessibility may be more important than transportation accessibility. For example, improving high-speed Internet connectivity could reduce isolation and limit the need for physical trips (e.g., health care advice through Skype was provided as one example). Participants also discussed the need for U.S. DOT to develop a Smart Rural Challenge to encourage digital and transportation infrastructure improvements in rural communities. Numerous participants identified multijurisdictional issues as a key challenge. For example, how can ridesourcing/TNC trips be subsidized with origins and destinations in different counties (or even crossing state lines)? One participant asked "What is the motivating price point to take an individual five miles out of their way to pool a ride and how much is someone willing to pay?"

This was identified as a key research question needed to inform future public policy on the potential gap needed to be filled by public subsidies. Some participants expressed concern that American Disability Act (ADA) requirements could prevent MOD from existing in rural communities. This participant expressed concern that MOD would cease to exist in rural communities if microtransit, ridesourcing/TNCs, or any other mode must be ADA accessible when there are fewer ADA users because of lower population densities. Some participants identified developing rural mobility hubs, allowing faith-based mobility subsidies, expanding commuter benefits to MOD (e.g., Internal Revenue Service deductions), and developing volunteer carpool driver programs as potential opportunities for the expansion of rural MOD.

Closing Thoughts and Key Takeaways

Shaheen and Chernick reunited workshop participants in the closing plenary session for a final workshop summary. MOD is gaining traction rapidly in most urban centers and is gradually expanding into less-urbanized locations. A number of key trends are encouraging the growth and expansion of MOD. These include technological, mobility, and societal trends.

TECHNOLOGICAL TRENDS

- Growth of cloud computing, location-based or satellite navigation services, and mobile technologies;
- The expansion of data collection, sharing, aggregation, and redissemination through crowdsourced, private-, and public- sector sources facilitated through advanced program interfaces and other third-party tools; and
- Ongoing development and deployment of advanced algorithms (enabling on-demand and flexible route service offerings), electrification, and automation.

MOBILITY TRENDS

- Increasing congestion, reduced funding, and the need to maximize existing infrastructure use; and
- Growing popularity of shared mobility and shared modes, such as bikesharing, carsharing, microtransit, and ridesourcing.

SOCIETAL TRENDS

- Greater environmental awareness about emissions and carbon footprints;
- Growth of megaregions as economic centers and transportation corridors; and
- Demographic changes such as rising life expectancies and an aging population.

WORKSHOP FOCUS

These trends over the past decade have helped fuel the growth and expansion of on-demand mobility. Public transit agencies are also acknowledging the need to physically and digitally integrate their services with MOD.

The workshop focused on many of these new developments and the convergence of Smart Cities, multimodality, and on-demand mobility. The panel sessions provided insight into developments on these topics, particularly the recent U.S. DOT initiatives of the Smart City Challenge and FTA MOD Sandbox, highlighting opportunities and challenges from experts from public agencies, academia, private companies, and technology futurists. The role of MOD and mobile technologies (e.g., smartphones, apps) was discussed in a variety of contexts and how

these innovations are changing the way people travel and make trips on a daily basis. The need for equity and not leaving anyone behind was highlighted throughout the panel and breakout sessions. It is important to be as inclusive as possible, especially to individuals lacking digital access, those living in lower-density communities, households of all socioeconomic backgrounds, and people with disabilities.

KEY INSIGHTS

Key insights and discussion points from the workshop are listed below:

- Key performance measures for smart cities and MOD are safety, affordability, reliability, and availability to all. Measuring these metrics requires a greater understanding and response to individual and societal goals, such as protecting traveler safety; understanding traveler needs and preferences; ensuring comfortable and convenient travel; advancing education, health, and safety; ensuring environmental sustainability; and more broadly, getting people to where they want to go.
- U.S. demographics are changing rapidly and so are technological trends. There is an increasing number of older adults aging in place and given the rise of automated vehicles and innovation in mobility services, there are opportunities for on-demand modes to enhance access for older adults, children, and people with disability.
- It is important to not only learn from Smart City and MOD successes but from failures as well. For instance, MOD may not have been as successful everywhere as it is in dense urban areas. There should be a focus on opportunities for enterprise commute solutions or transportation demand management stemming from employers.
- There is a big gap in rural MOD, and MOD solutions should be incorporated into rural communities. There are not many successful MOD solutions in rural areas. Sponsoring a Smart Rural Challenge to encourage digital and transportation infrastructure improvements in rural communities could be a start to address this gap.
- CNS, also referred to as flexible goods delivery, are on the rise and the business models could evolve to be used interchangeably for goods and people mobility. Two general emerging models of CNS are P2P delivery services and paired on-demand passenger ride and courier services. In addition to CNS, attention to the use of drones for goods delivery is important as it could disrupt the transportation ecosystem and provide many societal benefits. These areas need further research, as they are not well understood, at present.
- Multijurisdictions represent another key challenge area. For example, how can ridesourcing–TNC trips be subsidized with origins and destinations in different counties (or even crossing state lines)?
- Improving data sharing, data accessibility, and data integration are key to the success of MOD and Smart Cities. Moreover, there is a need for a platform that can integrate data seamlessly and provide the user with an easy access and simple payment method for all the transportation methods used in one origin–destination trip.
- Finally, it is important to align funding with priorities, recognize diverse traveler needs, improve understanding of the adoption of innovative technologies, and overcome barriers that exist with special populations that can potentially limit the availability or use of MOD and Smart City solutions.

The interactive breakout sessions provided an opportunity for the audience to get directly involved with the speakers after listening to the three panel sessions. A vibrant discussion ensued on potential use cases, opportunities, and challenges for expanding MOD in urban, suburban, and rural contexts. Many participants expressed the need to improve collective understanding of the impacts of MOD modes and opportunities for physical and digital multimodal integration. Broadly, the workshop facilitated a much-needed forum among experts and practitioners from diverse backgrounds and informed the audience about developments, challenges, and the future for Smart Cities and MOD.

Workshop Agenda

Sunday, January 8, 2017
9:00 a.m. to 4:30 p.m.
Walter E. Washington Convention Center
Washington, D.C.

Susan Shaheen, Transportation Sustainability Research Center (TSRC), University of California (UC), Berkeley, and Jeffrey Chernick, RideAmigos, presiding

Sponsored by the TRB Emerging and Innovative Public Transport and Technologies Committee (AP020); Shared-Use Mobility and Public Transit Subcommittee [AP020(1)]; Emerging Ridesharing Solutions Joint Subcommittee [AP020(2)]; Automated Transit Systems Committee (AP040); and the Transportation Demand Management Committee (ABE50)

Website: http://mobility2017.ml/

SESSION 1: 9:00a.m. to 9:30 a.m.
Workshop Overview and Participant Introductions

   Presenters: Susan Shaheen, TSRC, UC Berkeley; Jeffrey Chernick, RideAmigos

SESSION 2: 9:30a.m. to 10:30 a.m.
U.S. DOT's Smart City Challenge and
Columbus, Ohio's, Multimodal Vision from Columbus

   Moderator: Mark Dowd, Office of Management and Budget, White House

   Panelists (Columbus, Ohio): Spencer Reeder, Vulcan; Alex Fischer, Columbus Partnership; Aparna Dial, City of Columbus; Carla J. Bailo, Ohio State University (unable to attend); Guruprasad (Guru) Vasudeva, Nationwide

BREAK: 10:30 a.m. to 10:45 a.m.

SESSION 3: 10:45 a.m. to 11:45 a.m.
FTA's MOD Sandbox

   Moderator: Vince Valdes, FTA

Panelists (key cities and private-sector players involved in the FTA Sandbox): Gwo-Wei Torng, FTA; Chris Pangilinan, Transit Center; Steve Raney, Smart Mobility, Joint Venture Silicon Valley; Yi-Chang Chiu, University of Arizona and Metropia

AUDIENCE FEEDBACK: 11:45 a.m. to 12 p.m.

Moderators: Susan Shaheen, TSRC, UC Berkeley; Jeffrey Chernick, RideAmigos

LUNCH BREAK: Noon to 1:30 p.m.

SESSION 4: 1:30 p.m. to 2:15 p.m.
Public–Private Partnerships to Advance MOD

Moderator: Bob Sheehan, ITS JPO

Panelists (key private-sector and university partners from range of partnerships): Marcia Pincus, FHWA; Michael Berube, DOE; Jameson Auten, Kansas City; Mary Rose Fissinger, Bridj; Amanda Eaken, NRDC; Susan Shaheen, UC Berkeley

INTERACTIVE BREAKOUTS: 2:15 p.m. to 3:45 p.m.

Breakouts will include facilitated discussions on next steps, research needs, and documenting best practices to advance multi-modal mobility across topic areas (e.g., first-mile and last-mile, automation, equity, microtransit). Each breakout will have a facilitator and notetaker, as well as panelists from the earlier sessions. There could be as many as ten breakout sessions.

Facilitators: Allen Greenberg, FHWA; Prachi Vakharia, RideAmigos; Jana Sochor, Chalmers University; Stephen Zoepf, Stanford; Gary Hsueh, Arup; Justin Holmes, Zipcar; Amanda Eaken, NRDC; Emily Castor, Lyft; Katherine Kortum, Transportation Research Board; Sharon Feigon, Shared-Use Mobility Center; Shannon McDonald, Southern Illinois University Carbondale; Sabrina Sussman, NYC, Office of the Mayor; Balaji Yelchuru, Booz-Allen Hamilton; Katherine Freund, ITN America

BREAK: 3:45 p.m. to 4:00 p.m.

RAPPORTEURS REPORT BACK AND FINAL WRAP-UP: 4:00 p.m. to 4:30 p.m.

Presenters: Susan Shaheen and Jeffrey Chernick