CENTER OF EXCELLENCE
on New Mobility and Automated Vehicles

Mobility Center of Excellence

Five-Year Research Agenda

Version V1.0

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Contents

Changelog

The Mobility COE Research Agenda is a Living Document and will be updated periodically to reflect new research opportunities and demands.

Version	Date	Changes
1.0	1/16/25	First published version of the Mobility COE Research Agenda

Introduction

Scope

The Center of Excellence on New Mobility and Automated Vehicles ("Mobility COE") was established by the Infrastructure Investment and Jobs Act to "collect, conduct, and fund research on the impacts of new mobility and highly automated vehicles on land use, urban design, transportation, real estate, equity, and municipal budgets." The Federal Highway Administration (FHWA) awarded the Mobility COE to the University of California, Los Angeles (UCLA) and its research partners in fall 2023 and charged it with establishing a five-year research agenda to serve as a strategic roadmap that guides research initiatives and projects in the dynamic and ever-evolving field of new mobility.

Our vision is to position the Mobility COE as a leader in helping state and local governments and the industry achieve safe, efficient, and accessible transportation solutions that are well-integrated into a multimodal ecosystem.

Members of the Mobility COE are responsible for the agenda and the decisions that shape it; however, the development and continual refinement of this research agenda will be undertaken in consultation with the Steering Committee (SC). This collaborative process is essential to ensure that our research priorities are aligned with real-world needs as experienced by our stakeholder communities. By engaging the SC as we form and update the research agenda, we ensure that our initiatives remain focused, relevant, and capable of driving meaningful change.

As the chair of the SC, FHWA plays a pivotal role in reviewing and advising on the proposed research agenda. The FHWA's involvement helps our research efforts connect with, and contribute to, national priorities and the broad objectives of improving transportation infrastructure and systems across the country.

The research agenda is designed to be a living document, reflecting the dynamic nature of the mobility sector. It will be updated annually in consultation with the SC and stakeholders, allowing us to incorporate new insights, emerging trends, and evolving priorities. This iterative process ensures that our research remains at the forefront of innovation and continues to address the most critical issues in mobility.

Process

The development of this research agenda has been a thorough and collaborative process, involving several key steps to ensure its comprehensiveness and relevance.

Request for Information

We initiated the process with a Request for Information (RFI) to gather input from a broad range of stakeholders, including industry experts, academic researchers, transportation professionals, and public sector representatives. This step was crucial in identifying the current challenges, opportunities, and emerging trends in the mobility sector.

Literature Synthesis

Along with the RFI, we conducted an extensive literature review to synthesize existing research and identify gaps. This review encompassed academic publications, industry reports, policy documents, and case studies. The insights gained from this review provided a solid foundation for defining our research priorities and ensuring that our agenda builds on existing knowledge while addressing unmet needs. The synthesis is published as part of the COE clearinghouse.

Stakeholder Engagement

Engagement with stakeholders has been a cornerstone of the research agenda development process. Through workshops, interviews, and surveys, we solicited feedback from key stakeholders to refine our research focus areas. This engagement ensured that our research agenda is responsive to the needs of the community and aligned with the strategic goals of our partners.

By following this structured and inclusive process, we have developed a robust and forward-looking research agenda that will guide the Mobility COE's efforts over the next five years and beyond. This agenda not only reflects the collective insights of our stakeholders but also sets a clear path for advancing research and innovation in the field of new mobility and automated vehicles.

Research Thrusts, Methodology, and Planned Activities

This chapter aims to introduce the core research thrusts of the Mobility COE and key focus directions under each thrust. Then, approaches and planned activities are introduced to demonstrate how the COE will achieve the research and engagement goal.

Research Thrusts and Focused Areas

The COE operates under four major thrusts. Focal areas under each thrust are critical to understanding and optimizing the impacts of new mobility and automated vehicles.

Thrust 1: Mobility, Land Use, and Urban Planning

This research-based thrust investigates how new mobility technologies impact urban development and land use. Key areas include:

- 1.1 Land Use: Examining the potential of new mobility, including AVs, to stimulate mixed-use developments and reshape urban land use patterns, as well as how new land use can facilitate the adoption of new mobility technologies.

- 1.2 Real Estate: Analyzing the effects on parking demand, real estate development, and the configuration of buildings and blocks.

- 1.3 Urban Design: Assessing the demands on urban design, including curb usage, green spaces, and pedestrian areas, and the reversed impact of urban design on the adoption of new mobility technologies.

- 1.4 Municipal Budget and Financing: Evaluating the impact of new mobility on public infrastructure investments and municipal budgets.

Thrust 2: Systems Analysis and Optimization

This research-based thrust focuses on enhancing system-level safety, efficiencies, travel demand management, energy use, and the resilience and security of transportation systems. Key areas include:

- 2.1 System Safety: Examining safety impacts on pedestrians, cyclists, and other road users, as well as safety frameworks and strategies for integrating new technologies into existing transportation.

- 2.2 Mobility Efficiencies: Exploring the impact of new mobility on demand, congestion, and energy consumption.

- 2.3 Commercial and Freight Operations: Investigating the role of new mobility, especially AVs, in improving access to goods and services.

- 2.4 Multimodal systems: Determining the potential of new mobility in multimodal networks.

- 2.5 Data Strategies: Exploring data requirements, standards, and modeling for analyzing system impacts of new mobility technologies and services.

Thrust 3: Human-Centric Mobility and Society

This research-based thrust aims to ensure that new mobility technologies promote solutions for all and benefits across all societal segments. Key areas include:

- 3.1 Inclusive Use: Developing systems that are accessible, user-friendly, and thoughtfully designed to accommodate individuals with varying abilities, ensuring everyone can effectively utilize new mobility solutions.

- 3.2 Universal Access: Expanding the availability of transportation services to traditionally underserved communities, ensuring that all groups, regardless of location or circumstance, can benefit from advanced mobility technologies.

- 3.3 Holistic Societal Impacts: Examining the broader influence of mobility innovations on workforce development, community well-being, and social cohesion, ensuring that the transition to new systems supports positive outcomes across all populations.

- 3.4 Economics and Governance: Investigating sustainable economic models, service provision strategies, regulatory frameworks, and governance practices that enable safe, inclusive, and beneficial integration of mobility solutions into the fabric of society.

Thrust 4: Pathway Design and Outreach

This engagement-focused thrust aims to ensure that the COE research teams are aware of policy and pathway developments and that the work of the COE informs decisions and actions made by COE stakeholders.

- 4.1 Systematic Stakeholder Engagement: Facilitating collaboration with stakeholders both within the US and internationally to ensure broad-based input and support.

- 4.2 Case Studies: Understanding and analyzing policy and technical frameworks that support new mobility solutions, identifying practical examples and lessons learned through place-based case studies and roundtables.

- 4.3 Clearinghouses: Establishing repositories of knowledge, data, and lessons learned to serve as resources for stakeholders and researchers.

- 4.4 Events: Organizing webinars, podcasts, workshops, and symposiums to disseminate the COE's research findings and promote the exchange of ideas and best practices within the mobility community.

The Mobility COE has also selected 11 mobility services and technologies as the focus. The COE intends to evaluate these using 8 types of impact assessments.

Mobility services and technologies	Types of impacts
Vehicle Technology: 1. Automated Vehicles 2. Connected and Automated Vehicles 3. Connected Vehicles Emerging Passenger Mobility Options: 4. Micromobility: docked and dockless bicycles and electric scooters	1. Safety 2. System Efficiency 3. Accessibility 4. Municipal Budgets 5. Land Use 6. Education and Workforce 7. Energy and Environment

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5. Ridehail/Transportation Network Companies
6. Carsharing
7. Demand- responsive transit and microtransit

<u>Emerging Freight/Goods Movement Options:</u>
8. Heavy Duty Applications of Automated Vehicles
9. On-Demand Delivery Services

<u>Business Models:</u>
10. Mobility-as-a-service and related business models
11. Public private partnerships (P3) or hybrid models
12. Universal basic mobility

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8. Health

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Approach

The Mobility COE not only funds and conducts research but also emphasizes dissemination, partnerships, and engagement as central components of our methodology.

Engagement Activities

The research agenda for the Mobility COE encompasses a comprehensive approach that includes Engagement, Risk Assessment, Research Synthesis, Translational Research, and Research Projects.

Engagement	Risk Assessment	Research Synthesis	Translational Research	Research Project
Educational or service-oriented activities derived from research	Identifying real-world risks from knowledge gaps for prioritization of future research	A literature review applied to a specific problem	Adapting prior, robust research to a new problem context	An applied or major research study to address epistemological gaps

Engagement activities that develop educational or service-oriented programs from ongoing research. This ensures that findings are disseminated and utilized effectively within the community. Risk Assessment plays a crucial role in identifying real-world risks stemming from existing knowledge gaps, thus helping prioritize future research efforts. Research Synthesis involves conducting detailed literature reviews focused on specific problems, providing a strong foundation of existing knowledge. This synthesis supports Translational Research, which adapts robust prior research to new problem contexts, ensuring relevance and applicability. Finally, the agenda includes Research Projects, which are applied or major studies designed to address significant epistemological gaps, pushing the boundaries of current knowledge and contributing to substantial advancements in the field of mobility.

Research Dissemination

All the COE steering committee members have been engaged in individual meetings with the COE leadership between April and May of 2024. The first in-person committee meeting of the COE Steering Committee was at the 2024 Transportation Research Board Annual Automated Road Transportation Symposium (ARTS 2024) in San Diego. The Steering Committee discussed COE-funded projects using Year 1 and Year 2 funding, as well as provided comments on the five-year COE roadmap.

Website and Clearinghouse

In order to serve as a hub for information related to the COE and to disseminate research produced by the COE, the Mobility COE has established a website at https://www.mobilitycoe.org. On this website, the COE has established a clearinghouse of reports, plans, regulations, websites, academic publications, and government documents related to automated vehicles and new mobility and implications for one or more of: energy, health, land resource management, mobility equity, operations/efficiency, resilience/reliability, safety, security, V2X/connected infrastructure, and workforce equity. Below is a current list of categories of resources to be developed by the COE.

- Research Repository: A searchable and categorized database of research papers, studies, and analyses, including advanced search functionalities. Subcategories should include reports, papers, projects, data, tools, training/courses, topics
- Data Center: Access to datasets, visualization tools, and guides on data use and interpretation.
- Tools: Access to open source or online tools available for use; this could be linked to an additional website/webpage (such as Github), web tools, or online sand box/playground
- Training and Education: Details about online courses, webinars, workshops, and educational materials for different levels of expertise.
- Topics: Dedicated pages for key topics in mobility and AV, including articles, multimedia resources, and related research; this page will be a hub with all information linked to all internal and external resources for the most critical selected topics

- Resources and Links: A compilation of external resources, reading lists, toolkits, and guidelines.

Webinars and Events

The Mobility COE holds or participates in public events to discuss and disseminate research with potential stakeholders. This webinar series aims to foster a robust understanding of critical (or even controversial) issues, emerging trends, and challenges shaping the future of mobility. Through structured webinars, the COE seeks to facilitate dialogue, encourage collaboration, and promote innovative solutions within the mobility landscape. Another primary objective of the webinar series is to explore issues identified in the gap analysis that pose challenges for resolution due to limitations in COE resources or their inherent complexity. These webinars will provide opportunities to gather insights from top experts and guide research directions in those specific areas.

Mobility COE leadership and researchers have also identified core conferences and events to perform broader stakeholder engagement via invited presentations and panel discussion, workshop/technical session organization, and conference posters. The COE has designed and printed handouts for distribution at these events.

To sum up, the Mobility COE engages with stakeholders through one-on-one meetings, participation in conferences, and collaborative workshops. These engagements are crucial for building relationships, gathering feedback, and ensuring that the Mobility COE's research addresses real-world challenges.

Five-Year Research Agenda

This chapter outlines the Mobility COE's Five-Year Research Agenda, organized into nine clusters under the aforementioned four key thrusts:

- Land Use, Urban Design, and Real Estate
- Municipal Budgets and financing
- Systems Safety
- Multimodal Systems Efficiency
- Commercial and Freight Operations
- Mobility Data Strategies
- Human-Centric Mobility and Societal Well-Being
- Economics and Governance
- Pathway Design and Outreach

This comprehensive agenda is built upon a thorough literature synthesis, internal brainstorming and idea submission, and insights gathered from the Mobility COE public Request for Information (RFI). The agenda will be revised periodically, no less than annually, based on new research and emergent research needs identified through future focused RFIs.

1. Land Use, Urban Design, and Real Estate

This five-year research agenda for Land Use, Urban Design, and Real Estate aims to understand the dynamic changes brought about by new mobility technologies and their impacts on safe, sustainable, accessible, and efficient urban development. The following critical research gaps are identified:

1.1 Land Use and Zoning Adaptations

1.1.1 *Reassessing Zoning Regulations*

As AVs and shared mobility solutions become more prevalent, the demand for traditional auto-serving facilities will decrease, while the need for other types of spaces such as curbs and fleet servicing centers will increase. This necessitates a reassessment of zoning regulations to accommodate these changes.

1.1.2 *Framework for Autonomous Universal Access*

In the era of AVs, existing land use and building codes must evolve to ensure accessibility for all, including aging populations and individuals with disabilities.

1.2 Economic Implications to Parking from AVs and New Mobility

1.2.1 *Changing Business Models for Parking*

The introduction of AVs changes the landscape of public infrastructure, particularly parking, whether private or municipally owned. To understand impacts on municipal budgets and real estate, it is important to explore impacts on parking finances, planning, and operations to inform efficient and sustainable parking asset management.

1.2.2 *Real Estate Market Response to Reduced Parking Demand*

As AVs and micromobility reduce the need for parking, it is important to understand how the real estate market responds and how to repurpose existing parking spaces to meet new urban and suburban needs.

1.2.3 *Effects of Autonomous Valet Parking*

Autonomous valet parking, as a Day 1 application of AV technologies, can alter urban travel demand, energy use, and parking economics. There is a need for understanding the effects of autonomous valet parking on traffic operations and facilities, network efficiency, energy use, and urban parking demand, economics, and overall real estate development.

1.2.4 *Optimizing TNC and AV Pickup/Dropoff Areas*

There is a need to investigate the impact of geometric design on the efficiency, safety, and accessibility of TNC and AV pickup/drop-off areas. These designs can be optimized for better traffic flow, accessibility, safety, user experience, and urban design.

1.3 Active Curb Management Policies

1.3.1 *Jurisdictions with Active Curb Management Policies*

This aims to explore and classify the emerging efforts and outcomes of active curb management policies in various urban settings. There is a need to analyze how these regulatory approaches manage the diverse demands for curb space from services like goods delivery, ride-hailing, and highly automated vehicles.

1.3.2 *How Are/Will AVs Affect Popular and Political Resistance to Curb Management?*

This will assess the factors contributing to resistance against curb management changes prompted by the introduction of highly automated vehicles. It will identify strategies to overcome these barriers and enhance curb space utilization.

1.3.3 *Navigating the Future of Urban Design with AV PUDOs*

There is a need to analyze the impact of AVs on urban Pick-Up and Drop-Off (PUDO) locations. It needs to develop strategies for balancing on-street and off-street PUDOs to improve urban mobility and minimize traffic disruptions.

2. Municipal Budget and Financing

The Municipal Budget and Financing thrust aims to address the impact of new mobility on public infrastructure investments and financing. The following critical research gaps are identified:

2.1 Innovative Business Models for Public Good Applications

Many mobility applications have the potential to improve public good but face challenges in achieving financial sustainability. This includes applications like eco-driving and vehicle-collected road state monitoring. There is a need to develop stronger business cases for these applications to ensure they can be realistically sustained and implemented effectively.

2.2 Community-based versus Market-based Approaches to Shared Mobility

There is a need to comprehensively analyze non-profit community-based versus market-based approaches to shared mobility, including public-private partnerships (PPPs). This involves assessing the impact on urban mobility, sustainability, and socio-economic inclusivity, and identifying best practices for more efficient and universally accessible transportation systems.

2.3 Sustainable Funding Models for Shared Mobility Programs Supporting Low-Income Travelers

Shared mobility pilot programs for low-income travelers often rely on a combination of public subsidies and revenue generated through these services. Research is needed to evaluate whether revenues from these programs can offset the costs for low-income users (e.g., through cross-subsidization models) or if long-term public subsidies will be required to sustain these services. This research should also assess the scale of public subsidies necessary to ensure accessibility for low-income travelers.

2.4 Challenges and Opportunities for New Mobility on Municipal Budgets

As new mobility options grow, there is a need for cities and states to understand and capture the holistic social value and costs of different transportation modes, including micromobility and shared AV services. This may include considering the income and demographics of users to understand if pricing and other economic policies are regressive and therefore erode affordability and accessibility.

3. Systems Safety

This cluster aims to examine safety impacts on pedestrians, cyclists, and other road users, as well as safety frameworks and strategies for integrating new technologies into existing transportation. The following critical research gaps are identified:

3.1 Connectivity and V2X

3.1.1 *Risk-based Assessment of V2X-enabled Traffic Systems*

There is an urgent need for methods to enhance V2X cost-benefit analysis and develop decision support tools. This includes assessing reliability, connectivity, and traffic safety impacts, with a focus on various scenarios and conditions.

3.1.2 *V2X Mobility Benefits*

There remains a critical need to extend the evaluation framework to include generic mobility benefits in addition to safety. These include enhancements in energy efficiency, reductions in emissions, and overall improvements in transportation system efficiency at both facility and network levels. By broadening the scope of evaluation, agencies can make more informed decisions about the deployment of V2X technologies.

3.1.3 *Scalable V2X Options into the Future*

Evaluate the scalability and feasibility of V2X technologies, considering global advancements, diverse technological ecosystems, and risk assessments. This research

aims to determine effective deployment strategies for improving roadway safety and efficiency.

3.1.4 Scalable Smart Sensor Suite for Enhanced Transportation Systems

Future V2X systems will likely be integrated with advanced smart sensor suites to enhance traffic management, system efficiency, and road safety. By leveraging multi-modal sensor fusion—including cameras, radar, lidar, and other sensors—and V2X-based cooperative perception, transportation systems can significantly improve traffic detection capabilities, especially for vulnerable road users. However, to be practical and effective, these systems must be scalable and adaptable to different deployment scenarios. Research is needed to develop deployment strategies to determine when and where various sensor solutions should be implemented, based on operational warrants such as traffic volume, crash risk, and roadway conditions. Understanding cost-effective and prioritized deployment approaches will be critical for enabling broad adoption of smart infrastructure technologies.

3.2 Operational Safety of Highly Automated Vehicles

3.2.1 Operational Safety & System Requirements of Highly Automated Vehicles for Mobility-as-a-Service

Develop methodologies to quantify and mitigate risks associated with the operational safety of highly automated vehicles, ensuring robust safety protocols and guidelines for emergency situations.

3.2.2 Communication and interactions between Driverless AVs and Road Users

Develop standardized communication and interaction methods for driverless AVs to interact effectively with public safety personnel, road workers, and other road users, improving traffic safety and operational efficiency.

3.2.3 Developing a Safety-Centric Framework for Highly Automated Vehicle Integration

Conduct an in-depth analysis of policy frameworks governing highly automated vehicle deployment, focusing on safety implications and regulatory discrepancies, when integrating AVs into existing transportation, to help agencies evaluate and design safer transportation services.

3.2.4 Transportation Cybersecurity Analysis Framework

Develop a cybersecurity risk analysis framework for the transportation sector, addressing unique challenges posed by cyber threats and enhancing system resilience.

4. Multimodal Systems Efficiency

This cluster focuses on the impact of new mobility on demand, congestion, and energy consumption. The following critical research gaps are identified:

4.1 Mobility AI Networks:

4.1.1 Modeling and Simulation Testbeds

Create benchmarking platforms leveraging activity-based and agent-based simulations to evaluate new mobility solutions deployed at scale. This will serve as a resource for researchers to evaluate various innovative mobility solutions.

4.1.2   *Mobility AI Ecosystem*

Develop a platform for data sharing and management, simulation models, and data-driven mobility models (model zoos) to support the evaluation of emerging technologies and public policies. This also contributes to the overall USDOT AI initiatives, by understanding AI's role in designing and analyzing new mobility systems.

4.2 Mobility Hubs for Optimizing Urban Mobility

Utilize a data-driven model-based approach to strategically place mobility hubs, integrating various transport modes to enhance utility and environmental impact.

4.3 Addressing Inefficient Transit Service Gaps

Investigate how AVs can fill gaps in inefficient transit services, particularly during off-peak hours and in urban and suburban areas; evaluate the potential contribution of AVs to fill transit service gaps in rural areas.

4.4 Optimization of Automated and Electric Vehicles

Research is needed to understand the synergistic effect between AVs and EVs, since a potential future mode is shared electric AVs. One critical issue is fast charging for AVs, i.e., examining the benefits and challenges of scaling fast charging infrastructure and other advanced charging options (e.g., inductive wireless charging) for AVs to maximize their safety benefits and vehicle productivity.

4.5 Micromobility Data Analysis

Study the impact of e-scooters and other emerging mobility options on urban transportation systems and their interactions with transit ridership and bike-sharing. Multiple cities have initiated or even terminated their micromobility programs and it is meaningful to use these empirical data to understand the role of micromobility in overall transportation systems.

4.6 New Mobility Efficiency in Rural Scenarios

4.6.1   *Shared Mobility in Suburban and Rural Environments*

Explore promising shared mobility models for suburban and rural areas to safely reduce travel time and increase access among low-income households.

4.6.2   *Enhancing Evacuation and Emergency Response*

Evaluate the potential of new mobility solutions, like shared highly automated vehicles (SAVs) and other shared models, to improve evacuation and emergency response in rural and isolated areas.

4.6.3   *Healthcare Access in Rural and Marginalized Areas*

Explore the transformative potential of shared AVs in enhancing healthcare access for rural and marginalized communities.

5. Commercial and Freight Operations

This cluster investigates the role of new mobility, especially AVs, in improving access to goods and services. The following critical research gaps are identified:

5.1 Metrics for Delivery Robot Interactions with Pedestrians

The rise of delivery robots in urban environments has created friction between pedestrians and robots, especially for those with disabilities. There is a need for methods to measure the impact of delivery robots on pedestrian safety and to develop performance and safety metrics for their operations.

5.2 Implications of Autonomous Delivery Robots for Easing Traffic and Curb Access Demand from Urban Delivery

The surge in online shopping has increased urban delivery traffic, leading to congestion and intensified demand for curb space. Autonomous delivery robots (ADRs) could mitigate these issues, but there is a need to explore their potential impact and develop tools to assess their effectiveness in diverse urban environments.

5.3 Navigating the Future of Urban Design with Autonomous Vehicle Pick-Up and Drop-Off Locations (PUDOs)

The introduction of AVs reduces the need for parking spaces, impacting urban design and curb space utilization. Efficiently managing on-street versus off-street PUDOs is critical for minimizing traffic disruptions and enhancing mobility, necessitating research into the optimal balance and its implications for urban development.

5.4 Transformation and Challenges in the Courier and Logistics Industry within Multimodal Urban Three-Dimensional Transportation Systems

Multi-modal urban transportation systems, integrating ground vehicles, drones, and aerial vehicles, offer potential for optimizing urban logistics. However, there is a lack of systematic research on their practical operations, cost-effectiveness, and impact on existing logistics networks.

6. Mobility Data Strategies

This cluster explores data requirements for analyzing system impacts of new mobility technologies and services. The following critical research gaps are identified:

6.1 Enhancing AV Safety with Standardized City Data

Cities need standardized mobility data specifications to include key data from AVs to ensure safety, quality of service for all communities, and effective incident management. Research is needed to define the exact fields to be included in the data specifications and to structure them for effective data sharing and collaboration between public agencies and AV providers. Additionally, AVs currently lack access to standardized city data that could help avoid conflicts with key stakeholders like first responders and construction workers. There is a need to inventory critical data produced by public agencies, such as real-time 911 logs and work zone permits, to create automatic geofences for AVs, enhancing their operational safety and efficiency.

6.2 Leveraging AV Observational Data for Urban Management

AV operators collect extensive observational data on street conditions that could benefit city management of urban infrastructure. There is a need to identify what types of data are valuable to cities, how they are willing to pay for it, and how this data can be integrated into municipal systems to generate actionable insights. This project seeks to explore these challenges and opportunities through stakeholder engagement and research.

6.3 Mobility Data Fusion and Modeling

Modern mobility systems generate data from diverse sources such as travel diaries, time-use surveys, GPS traces, business transactions, OEM vehicle trajectory data, AV sensors, and points of interest (POI) datasets. These datasets vary in resolution, quality, and the travel stages they represent, making it challenging to fuse them into coherent insights for transportation modeling. Research is needed to develop data fusion and modeling solutions that integrate these fragmented sources to derive comprehensive mobility patterns, address data gaps, and improve accuracy across various applications.

7. Human-Centric Mobility and Societal Well-Being

The cluster addresses all aspects of designing and implementing new mobility systems in a human-centric manner. The following critical research gaps are identified:

7.1 Inclusive Use and Design

7.1.1 Accessible Rendezvous with Automation at the Curb

Address barriers to AV services for people with disabilities by gathering input from stakeholders on improving rendezvous points and service features. This aims to identify best practices for policy makers and service providers to enhance accessibility and reduce service denial incidents for people with disabilities.

7.1.2 Standards for AV Access for People with Disabilities

Investigate the accessibility of AVs for people with disabilities. This research will assess the current state of AV services, identify gaps in service, and propose standards for improving accessibility. The goal is to ensure AV technology benefits all users, including those with mobility and sensory disabilities.

7.2 Universal Access

7.2.1 Ensuring Access and Overcoming Barriers to AV Deployment for Social Mobility in Low-Income Communities

Investigate how AVs can enhance social mobility in low-income communities by identifying and addressing barriers to technological adoption. This includes addressing issues such as technological literacy, socio-cultural dynamics, infrastructure inadequacies, and economic limitations. There is also a need to explore new economic models to sustainably finance AV services in underserved areas, aiming to improve access to essential services and opportunities through advanced mobility solutions.

7.2.2 *Analyzing New Mobility Data from Universal Basic Mobility Programs*

Analyze data from Universal Basic Mobility (UBM) programs to understand the role and efficacy of new mobility solutions, such as ride-hailing and micro-transit, in enhancing transportation access for low-income communities. A combination of trave survey, positive trajectories, and transaction data can be fused to assess how these funds are spent and the impact on mobility patterns.

7.2.3 *Identifying Accessibility Gaps through NREL's MEP Tool*

Use the Mobility Energy Productivity (MEP) tool to assess transportation system effectiveness in connecting people to essential activities. This research will compare MEP scores with 15-minute city frameworks across multiple cities to identify accessibility gaps, particularly for disadvantaged populations. The analysis will highlight areas where transportation access disparities exist and propose how new mobility solutions might improve access and efficiency.

7.2.4 *Developing Accessibility-Focused Planning Tools to Improve First and Last Mile Mobility Using Micromobility Services*

Develop planning tools to improve transportation access in low-density areas by leveraging micromobility services like bike and scooter share. This project will focus on how these services can complement public transit and enhance mobility for underserved populations.

7.2.5 *Shared Mobility Approaches in Suburban Environments*

Explore effective models for shared mobility services in suburban areas, focusing on car-sharing, scooters, and bike-sharing. This research aims to identify promising approaches that can reduce congestion and increase access to transportation for low-income households in suburban settings, addressing the unique challenges of low to medium density and dispersed populations.

7.3 Holistic Societal Impacts

7.3.1 *Workforce Economic Inclusion and New Mobility*

Explore alternative workforce models in the new mobility industry that enable economic inclusion, such as profit-sharing and cooperative models. This project will develop case studies and analyze policies that affect jobs in the evolving transportation sector.

7.3.2 *Assessing the Impact of AVs on Disadvantaged Groups*

Evaluate the potential benefits of AVs for disadvantaged groups, such as low-income households and individuals with disabilities. This project will assess different AV ownership models and their impacts on congestion, mobility, and accessibility, aiming to develop strategies for making AVs more accessible and cost-effective while managing congestion from changes in travel demand.

7.3.3 *Mobility for All: A Multimodal Accessibility Framework for Diverse Income Groups*

Develop a multimodal network modeling framework to evaluate how new mobility options—such as shared mobility, micromobility, and autonomous vehicles—impact job accessibility across income groups. The project will assess cost, time, and reliability across both traditional and emerging modes to identify accessibility gaps and propose

investments and policies that maximize the benefits of new mobility solutions for underserved communities.

8. Economics and Governance

This cluster investigates economic development, service provision, and regulation and governance frameworks. The following critical research gaps are identified:

8.1 Regulatory Balance on New Mobility

Cities often impose fees, permits, and specifications on new shared mobility programs like scooter-share, bikeshare, and carshare. This project aims to quantify the impact of these regulations, categorizing them and establishing an index to measure their magnitude. By analyzing the extent to which these regulations predict shared mobility services, the study identifies barriers to implementation. In this study, it is also necessary to understand the importance of regulations to ensure mobility systems performance and therefore a balanced approach should be taken.

8.2 Effective Regulatory Frameworks for Transportation Network Companies (TNCs)

This project investigates existing TNC regulatory frameworks worldwide, conducts stakeholder analysis, and explores the impacts of TNCs on safety, traffic, public transportation, employment, accessibility, and sustainability. The aim is to understand the current state and efficacy of TNC regulatory frameworks and how this may carry over to other emerging mobility options.

8.3 Impact of TNCs on City Transportation Goals and AV Ride Sharing Regulations

Cities need data on the impact of TNC services on their transportation goals to prepare for highly automated vehicle fleets. This project evaluates the real impact of TNCs on city transportation goals and uses these findings to create requirements for AV service providers, ensuring their services align with city goals and fostering industry-city collaboration.

8.4 Insurance Ratings for AVs

Investigating the potential for developing insurance rating processes for AV services based on existing information, this project aims to collaborate with insurance agencies to establish the technical underpinnings for insuring CAV services.

8.5 New Mobility and Jobs

This project explores labor leaders' and workforce development professionals' perspectives on new mobility, identifying opportunities and challenges arising from technological shifts in passenger and goods movement.

9. Pathway Design and Outreach

This cluster aims to ensure that the COE research teams are aware of policy and pathway developments and that the work of the COE is valuable to stakeholders. The following critical research-related stakeholder collaboration gaps are identified:

9.1 City AV Deployment Workshop

Cities sometimes lack a clear understanding of what they want from potential AV deployments. Facilitated workshops can help cities articulate their needs and goals regarding AV deployments, involving key stakeholders such as NACTO, the National League of Cities, and the Knight Foundation.

9.2 AV-Supportive Land Use Pilot Community

This project involves working closely with a jurisdiction supportive of CAV planning and willing to adopt innovative transportation policies and zoning regulations that encourage shared automated vehicles and restrict individual vehicle ownership. The team will work with the jurisdiction to explore and evaluate planning innovations.

9.3 Citizen Voice and New Shared Mobility

Public participation often delays and adds expenses to early deployments of active and shared new mobility services. This study aims to identify the public participation procedures used by city departments of transportation, their impact on new mobility project timelines and costs, and the extent to which public input influences project support and litigation.

9.4 Stakeholder Roundtables for AV and New Mobility Strategies

Conducting deep-dive stakeholder roundtables in selected cities (e.g., LA and a Sunbelt city) can help develop comprehensive AV and new mobility strategies, involving all local public and private stakeholders.

9.5 International Research Collaborations

There is a need to develop an international network of research programs to support the Mobility COE priorities. This involves leveraging international funding and expanding learning to create influential, far-reaching research programs. Systematic and centralized approaches are necessary to identify complementary research centers and projects.

9.6 New Mobility and Automated Vehicles Wiki

Creating a user-editable wiki for themes related to the COE can help disseminate information and facilitate collaboration. The challenge is to ensure the content remains current and to attract a sufficient volume of contributors while managing spam.

Summary

The five-year research agenda for the Mobility Center of Excellence (Mobility COE) is designed to address the critical challenges and opportunities within the evolving transportation landscape. This agenda aims to foster innovative and collaborative partnerships across industry, government, and academia in order to design and implement safe, efficient, and accessible mobility solutions. This work will be focused across four major thrusts: Land Use and Urban Planning; Systems Analysis and Optimization; Human-Centric Mobility and Societal Well-Being; and Pathway Design and Outreach. Each thrust is supported by targeted research projects that collectively advance the field of transportation.

Mobility, Land Use, and Urban Planning

This thrust explores the potential of new mobility technologies, including highly automated vehicles (AVs), to reshape urban land use patterns and stimulate sustainable development. Key projects include developing frameworks for AV-supportive land use and vice versa, identifying pilot communities for integrating land use with CAV planning, and evaluating the impact of AVs on urban design and curb management. These efforts aim to understand the interactions between new mobility, land use, and the resultant impacts on traveler accessibility, affordability, congestion, and livability.

Systems Analysis and Optimization

Focused on optimizing transportation systems for safety, efficiency, and resilience, this thrust includes projects such as modeling and simulation testbeds for new mobility solutions, optimizing control strategies for integrated automated and electric vehicles, and assessing the potential of new mobility to enhance evacuation and emergency response in rural and isolated areas. These projects leverage advanced simulation models and data analysis to improve system performance and address challenges posed by new mobility technologies.

Human-Centric Mobility and Society

Addressing the social impacts of new mobility technologies, this thrust will study ways to improve access and use. Research projects focus on overcoming barriers to CAV deployment in low-income communities, developing frameworks for autonomous universal access, and leveraging new mobility to improve healthcare access in rural and marginalized areas. Additional projects will investigate the role of multimodal travel for low-income households and evaluate the impact of AVs on disadvantaged groups, ensuring all communities benefit from transportation advancements.

Pathway Design and Outreach

Emphasizing collaboration, knowledge dissemination, and stakeholder engagement, this thrust includes initiatives such as developing international research collaborations, creating a user-editable wiki for new mobility and AV themes, and conducting stakeholder roundtables to develop AV and new mobility strategies. Other projects focus on facilitating workshops to help cities articulate their goals for AV deployments and understanding the role of public participation in transportation projects. These efforts aim to maximize the impact of the Mobility COE's work through a collaborative and inclusive research environment.

Methodology and Other Activities

The Mobility COE employs a comprehensive approach to achieve its research goals. Key components include:

- **Engagement:** Educational or service-oriented activities derived from ongoing research to ensure findings are disseminated and utilized effectively within the community.

- **Risk Assessment:** Identifying real-world risks from existing knowledge gaps to prioritize future research efforts.

- **Research Synthesis:** Conducting detailed literature reviews focused on specific problems, providing a strong foundation of existing knowledge.

- **Translational Research:** Adapting robust prior research to new problem contexts, ensuring relevance and applicability.

- **Research Projects:** Applied or major studies designed to address significant epistemological gaps, pushing the boundaries of current knowledge and contributing to substantial advancements in mobility.

The Mobility COE ensures its research reaches a broad audience through several initiatives. Steering committee members actively engage with COE leadership in regular meetings. In the first year, this culminated in an annual in-person meeting at the 2024 Transportation Research Board Annual Automated Road Transportation Symposium (ARTS 2024) in San Diego. These meetings are essential for discussing and approving COE-funded projects and refining the five-year COE roadmap. Additionally, the COE has established a comprehensive website at https://www.mobilitycoe.org, which serves as a central hub for information. The website features a clearinghouse of reports, plans, regulations, academic publications, and government documents related to automated vehicles and new mobility, covering topics like safety, accessibility, affordability, energy, and health. To further its outreach, the COE launched a webinar series in March 2024. This approach ensures the COE's research is accessible, engaging, and impactful.